

INDIAN SCIENCE CONGRESS ASSOCIATION

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PROCEEDINGS OF THE FORTY-NINTH SESSION CUTTACK-1962

PART IV LATE ABSTRACTS, DISCUSSIONS, LIST OF MEMBERS AND INDEX



PROCEEDINGS OF THE FORTY-NINTH INDIAN SCIENCE CONGRESS CUTTACK, 1962

PART IV

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PROCEEDINGS OF THE FORTY-NINTH INDIAN SCIENCE CONGRESS CUTTACK-1962

PART IV

LATE ABSTRACTS

Section 1, Mathematics

1. "On a new set of Postulates defining a field".

M. A. KAZIM, M. U. Aligarh.

G. Robinson has defined a field in terms of modern operation A.J.M. Vol. 59, pp. 385-392 (1937). The author here defines a field with 'right subtraction "-" and 'right division' : "/" as binary operations and proves that any arbitrary system $(F, -, /)$ satisfying the following postulates and definitions is a commutative field.

F_0 : \exists at least two distinct elements in F

Def. 1 : $xy = x - y$. Def. 2 : $xx = 0$ for any $x \in F$

FS_1 : $xy \in F$ for $x, y \in F$

Def. 3 : $x^* = 0x$

FS_2 : $(xy^*)z = x(zy)$ for $x, y, z \in F$

FS_3 : $xy = z \Leftrightarrow zy^* = x$

Def. 4 : $x + y = xy^*$

FS_4 : $xy^* = yx^*$

FD_1 : $x/y \in F, y \neq 0$

Def. 5 : $x/x = 1 \in F, x \neq 0, 1 \neq 0$

Def. 6 : $1/x = x', x \neq 0$

FD_2 : For $x, y, z \in F, (x/y')/z = x/(z/y)$

where $y \neq 0, z \neq 0$

FD_3 : $x/y = z \Leftrightarrow z/y' = x, y \neq 0$

Def. 7 : (i) $xy = x/y', y \neq 0$

FD_4 : $x/y' = y/x, x, y \neq 0$

(ii) $x0 = 0$ otherwise

D.L. I $(yz^*)/x' = (y/x') (z/x')^*, x \neq 0$

D.L. II $x/(yz^*)' = (x/y') (x/z^*)', y \neq 0, z \neq 0, yz^* \neq 0$

Section II, Statistics

1. Solution of a Multiple-decision Problem with Two-stage Sampling.

JAYANTA KUMAR GHOSH, Calcutta.

The unknown mean θ of a random variable x distributed normally with unit s.d., is $0, -\Delta$ or Δ . The possible terminal decisions, d_0, d_{-1}, d_1 are those of accepting H_0 ($\theta=0$) or H_{-1} ($\theta=-\Delta$) or H_1 ($\theta=\Delta$). The loss is W_j if H_j is true but d_j is not chosen, otherwise the loss is zero. The cost under H_j is C_j . The Bayes solution for a given a-priori distribution (g_{-1}, g_0, g_1) is studied. Since the case $W_{-1}=W_1=W>0, C_{-1}=C_1=0, C_0>0, g_j=(1-g_0)/2; j=-1, 1$ is simple but brings out the main ideas; this case is considered first. The required extension is then made concisely. The result for the above simple case is described below.

An S-type rule $T(A, B, C)$ where A, B, C are positive constants is defined as follows:—If $x_1 > A$ accept H_1 ; if $x_1 < -A$ accept H_{-1} ; if $-B < x_1 < B$ accept H_0 ; otherwise observe x_2 . At the second stage accept H_1 if $x_1 + x_2 > C$ accept H_{-1} if $x_1 + x_2 < -C$ accept H_0 if $-C < x_1 + x_2 < C$ (The decision boundaries belong to each of the two contiguous regions). It is shown that if the Bayes solution is to have the structure S then some conditions stated in the paper are necessary. Conversely these conditions are sufficient to determine the $T(A, B, C)$ which is Bayes among S-type tests. It may be observed that these Bayes tests minimise the A.S.N. under H_0 among all tests with same or larger chances of making right decisions.

2. Probabilistic Investigation of a Single Server Queueing Process with Poissonian Input and Batch Service.

LAKSHMI VENKATARAMAN, Bombay.

This paper highlights some of the interesting methods employed by the author in the study of the above problem in her doctoral dissertation at Columbia University, New York.

Let $\tau_1, \tau_2, \dots, \tau_n, \dots$ be the instants at which the customers arrive at the counter. Then the interarrival times $\theta_n = \tau_n - \tau_{n-1}$ ($n=1, 2, \dots, \tau_0=0$) are assumed to be independent and identically distributed random variable with distribution function

$$P\{\theta_n \leq x\} = \begin{cases} 1 - \exp(-\lambda x) & \text{if } x \geq 0. \\ 0 & \text{if } x < 0 \end{cases}$$

If the customer arrives at an instant when the server is idle, then his service starts immediately. Otherwise he waits in the queue from which the customers are served according to the following service mechanism. The "first come—first served" policy is used only to study the waiting time distribution. There is one server at the counter. A service period commences only when there is some customer waiting in the queue to be serviced. The customers are served in batches where the size of the batch equals $\min.(j, m)$ where j is the queue size at the start of the service period and m is a known constant. The service times x_n^* of the n th batch ($n=1, 2, \dots$) are assumed to be identically distributed independent positive random variables with an arbitrary distribution function $H(x)$, and independent of the sequence $\{\tau_n\}$. Let $\tau'_1, \tau'_2, \dots, \tau'_n, \dots$ ($\tau'_0=0$) denote the instants of the successive departures.

Define

$\xi(t)$ = the number of customers waiting in the queue or being served at the instant t .

$\xi_n = \xi(r'_n + 0)$ = queue size immediately after the departure of the n th batch.

$\eta(t)$ = virtual waiting time at the instant t .

$\zeta(t)$ = number of people waiting to be served in the queue at the instant t .

η_n = waiting time of the customer arriving last among those who are served in the n th batch.

The transient behaviour of the stochastic processes $\{\eta(t)\}$, $\{\xi(t)\}$ and $\{\zeta(t)\}$ and of the stochastic sequences $\{\eta_n\}$ and $\{\xi_n\}$ is investigated, from which the asymptotic behaviour of these processes is obtained by the theory of Markov chains and renewal theory. The stochastic law of the busy period and the distribution of the number of services in a busy period are also obtained.

3. On Certain Aspects of Asymmetrical Factorial Designs.

K. C. RAUT and M. N. DAS, New Delhi.

In recent times a good amount of work has been done to construct asymmetrical factorial designs. While constructing such designs usually care is taken to make the designs balanced. There is one more important requirement for such designs. They should be such that different affected main effects and interactions should be estimable mutually independently. If this is not satisfied, usually the error component for such designs cannot be obtained. A systematic method of investigating whether the affected interactions are estimable mutually independently through any particular design has been presented in the paper. An example to show that even though a design is balanced and the total loss of information is one less than the number of blocks per replication, the affected interactions cannot be estimated mutually independently through it, has also been given.

4. Recovery of Inter Block Information.

J. ROY and K. R. SHAH, Calcutta.

The main problem in using inter block information for the purpose of estimating treatment effects consists in obtaining a suitable estimate of the ratio of inter-block variance to the intra-block variance. The method suggested by Yates and later on adopted by Rao makes use of the block sum of squares adjusted for treatments and of the error mean square in the ordinary analysis of variance. In this paper some alternative methods are suggested. The maximum likelihood estimates of all the parameters are obtained and an iterative procedure to arrive at these is also given. To derive the results an orthogonal transformation from the yields to uncorrelated inter and intra-block contrasts is used but the final computations do not involve the explicit use of this transformation.

5. On Simple Random Sampling with Replacement.

P. K. PATHAK, Calcutta.

In simple random sampling with replacement, Basu (1958) and Des Raj and Khamis (1958) have shown that for estimating the population mean, the average

of distinct units is more efficient than the overall sample mean. In this paper, a detailed treatment of the above problem is given; it is proved that the variance of the above estimator is given by :

$$V(\bar{y}_p) = \frac{1^{n-1} + 2^{n-1} + \dots + (N-1)^{n-1}}{N^n} S^2 \dots \dots \dots (1)$$

where \bar{y}_p is the average of distinct units in the sample, S^2 is the population variance, and n and N are sample and population sizes respectively. Several other estimators of the population mean are suggested and their relative efficiencies are compared. It is found that the above estimator has smaller variance than the well-known Horvitz-Thompson estimator if the coefficient of variation of the population is less than a given quantity and worse otherwise. Unbiased estimators of $V(\bar{y}_p)$ are given and their relative performance is studied with the help of a numerical example.

An improved estimator of the population variance is also derived. Lastly, a comparison between the two simple random sampling schemes (with and without replacement) is made for the purpose of estimating the population mean.

6. On the Necessary and Sufficient Assumptions for the Best Estimator in the theory of successive two stage sampling.

B. D. TIKKIWAL, Dharwar.

The general theory of successive two-stage sampling has been studied by the author (Ann. Math. Stat., Vol. 29 (1958), pp. 1291). The best estimator on the h th occasion is obtained there under a specified correlation pattern, showing thereby that the assumptions regarding correlations on h ($h \geq 2$) occasions were sufficient for the best estimator of the form. It is shown here that if we want to have this form of the best estimator, it is necessary to have such assumptions regarding correlation of coefficients.

7. Use of Out-dated Frames in Large Scale Sampling Surveys.

K. C. SELA, Simla.

In planning a large scale sample survey it is often found that the available frame from which the sample could be drawn is not up-to-date. In a dynamic population the sample thus drawn does not, therefore, remain fully representative of the population existing during the period of the survey. Unless some adjustments are made on the data collected during the survey, estimate of any population characteristic would be somewhat biased. In this paper some simple methods have been suggested on the basis of a reasonable birth and death process (for taking into account of the changing population) which could be easily worked out in most of the practical situations. Some illustrations explaining the suggested methods have also been given.

8. Scrutiny of Working-sheets by Control Charts.

S. P. MUKHERJEE, Calcutta.

With manual tabulation, errors are likely to arise in the transcription of information on the questionnaire to the working sheet. To assess the accuracy, sample checks may be called for. In this paper an objective procedure has been

suggested by which to judge from sample checks whether or not to examine an entire schedule for the case of m transcribes each working with a schedule containing k items of information for each of l units. The method consists in preparing a group control chart for fraction defective, each item being treated as a subgroup, the fraction defective being computed from a random sample of units. Varying numbers of units have been considered and the method extended to the case of a transcriber handling a number of questionnaires.

9. Statistical Evaluation of Pregnancy Wastage.

S. P. MUKHERJEE and D. BANERJEE, Calcutta.

Abortion rate as an indicator of wastage of pregnancy may be defined either for a cohort of mothers or for a cohort of pregnancies (or conceptions). The rate in current medical practice defined as the ratio of abortions to contemporary labour cases gives no estimate of the probability that a given conception will end in an abortion. For long-term calculations, end effects become negligible and the latter rate can be approximated by the ratio of abortions to all contemporaneous conceptions. While the former rate allows of a study of long-term trends, the latter is best suited to detect short-term (e.g. seasonal) variations. To derive the latter rate from the monthly totals of labour cases and abortions, one must introduce the concept of distributed lags between these two eventualities. Lacking data in respect of the gestation period prior to each abortion, lag regressions (for lags 3 to 8) may be used to estimate the 'exposure'. Exact and estimated rates have been computed from several hospitals in India for the quinquennium July 1954 to June 1959. This analysis however neglects intra-uterine foetal deaths.

Section III, Physics

1. More exact solution for non-local-potential in alpha-decay.

M. L. CHAUDHURY, Dhanbad.

It was shown recently (Chaudhury, Physical Review Letters, 5, 215, 1960) that the barrier penetrability for alpha-disintegration requires to be calculated by taking coulomb-field superposed by a non-local potential. The remarkable effect of the non-local part of the nuclear barrier on the penetrability has also been discussed there. However, the modified Shroedinger equation including an approximate delta function for the velocity-dependence and Igo potential for the static part leads to an equation which was solved by neglecting as small the first and second derivatives of the radial part of the eigenfunctions involved in the equation. Moreover, the equation was solved by the well-known W.K.B. method of approximation for mathematical simplicity.

In the present paper we have eliminated both these simplifications and have obtained more exact solutions by taking into consideration the part of the equation involving 1st and second derivatives (previously neglected) and instead of W.K.B. solution we have obtained solution in terms of spheroidal functions given by Meixner in a different context in his book.

The more exact eigenfunctions obtained lead to the same effect of non-locality for alpha-decay penetration. The detailed paper will be published elsewhere.

2. Achromatisation of thin films.

DR. V. RAMAKRISHNA RAO and K. C. MATHUR, Dehra Dun.

In the preparation of semireflecting optical components by the vacuum evaporation method, one disadvantage is the chromatic aberration of the transmitted and reflected light. The resultant colours are characteristic of the dielectric material used as well as the thickness of coating. It was found however possible to remove these colours and attain a neutral tint both in transmission and reflection.

Blanks coated with iron and oxidised suitably were found to have an orange yellow colour. When these were further coated with Magnesium Fluoride and Zinc Sulphide of suitable thicknesses (of the order of $\lambda/4$), neutral transmission and reflection could be obtained. It was also found that a neutral transmission and any specified reflected colour could be obtained by altering the thicknesses of MgF_2 . In addition to thicknesses, the polarisation characteristics possibly explain the neutral tinge of the transmitted light. This kind of spectral contrast is of special requirement in some optical instruments.

Transmission and reflection coefficients of 50% and 30% respectively could be obtained with these specimens. These methods have the additional advantage of strong adhesion of the coatings to the substrate.

3. Seasonal variation of atmospheric ozone in India and some ozone-weather relationships.

S. RANGARAJAN, Karaikudi

An analysis is made of the total ozone amounts determined at the four regular ozone stations in India during the period 1958 to 1960. While the ozone content at Srinagar and Delhi is relatively higher during January-April, that at Kodaikanal is relatively higher during June-September. A very interesting feature of the ozone distribution in India is the reversal of the latitudinal gradient of total ozone during the monsoon season which leads to higher ozone in the south than in the north. A possible mechanism to account for this reversal is suggested in terms of seasonal variations in the tropopause height. Good correlations are observed between day-to-day fluctuations in the ozone at Srinagar and changes in the 500 mb contour heights at Delhi caused by the movement of disturbances in the westerlies. A case study of an abnormal increase of ozone in association with a western depression in March 1960 is also discussed. The increase of ozone is apparently caused more by vertical descent of stratospheric ozone-rich air than by advection of northerly winds.

4. The "Optical Contact Method" for production of optical flats.

R. HRADAYNATH, Dehra Dun.

The use of optical flats satisfying the Rayleigh limit of image formation i.e. with surface accuracies of the order $\frac{\lambda}{8}$ in a large number of precision instruments particularly of the interferometric type is well known, apart from its use in reflecting telescopes as diagonal mirrors. The present method of making optical flats is very much dependent on the skill of the worker and his ability to correct both his job and his polisher during the final stages. The procurement difficulties (apart from the cost involved) are so large that one is always deterred from trying out new designs in interferometric instrumentation. In fact such difficulties in our laboratories led the author to try out a new

production technique based on the 'optical contact method' and the use of optical tools of much larger diameter. This has resulted in a comparatively easy and accurate production of an otherwise highly skilled and laborious job. Optical flats, 60-80 media to an accuracy of $2/12$ were produced and tested on an interferometer. Accuracy was further improved to $1/25$ by handworking.

5. Wave Shaping Circuit for use in Automatic Accompaniment.

H. V. MODAK, Poona.

'Wave Shaping Circuit' has been developed for improving the working of the Automatic Musical Instrument invented by the author. The Automatic Musical Instrument is a string instrument which plays automatic accompaniment to vocal music. It works on the principle of resonance. Notes of vocal music are picked up by a microphone and the electrical variations are amplified. The amplified current is passed through the 'Wave Shaping Circuit' which gives either a saw-tooth or pulse wave shape to the vocal tone. The circuit changes vocal music into instrumental musical tones. Output current from the Wave Shaping Circuit is further amplified and is passed through a reed motor. Vibrations of the reed are communicated to a set of strings, tuned according to the notes of the musical scale used. When different notes are sung, the strings corresponding to these notes are set into vibrations in the same sequence, and thus the accompaniment is obtained. Accompaniment of the instrument is similar to that of bowed strings of the violin type.

Vibrations of the reed are also loosely coupled to the sounding board on which the strings are stretched. So when the notes are sung exactly in tune the corresponding strings and the sounding board vibrate, while for intermediate tones between any two tuned strings, the instrumental musical sound is emitted by the sounding board, thus maintaining the continuity of tones. Thus with the use of the wave shaping circuit additional strings for intermediate tones are not required. The paper describes the working of the Wave Shaping Circuit.

6. The specific Heat and Neutron Scattering from Graphite.

L. S. KOTHARI and J. MAHANTY, Chandigarh.

In this paper an attempt is made to correlate the effect of the dispersion of the vibrational frequencies of the Graphite lattice with (a) the specific heat data, and (b) the cross section of inelastic scattering of cold neutrons from the lattice. A frequency distribution function having a logarithmic singularity is chosen, and the parameters are fixed by the specific heat data.

7. Anomalies in the Directional Intensity Pattern of Cosmic Radiation at 25° N Geomagnetic Latitude—II.

M. K. KHERRA, Gulmarg (Kashmir).

In continuation of the results reported last year in the Indian Science Congress on the presence of the fine structure in the zenithal intensity curves in the southern azimuth, further data have been collected in other principle azimuths and is being analysed. The data have been obtained with four-fold and three-fold coincidence telescopes having the apertures as $2^{\circ} \times 33^{\circ}$ and $2^{\circ} \times 22.5^{\circ}$ in the east-west and north-south planes respectively. The preliminary analysis shows that the anomalies in the northern azimuth do not exist, outside the errors of the

experiment, a result which differs from the earlier report made on the southern azimuth.

The data further reveal that a unique value of the exponent of the empirical relation, i.e., $N=I_0 \cos^2\theta$, governing the zenithal intensity gives a good fit which is also contrary to the earlier results.

8. Ion-Free Radical Equilibrium in the (n, γ) Recoil Products.

H. J. ARNIKAR and A. LAL, Varanasi.

Results are reported for the relative proportion of free radicals and ions in equilibrium in the (n, γ) recoil products of bromine, the presence of ions of both signs in the recoil products having been established in our earlier work. Thermalised neutrons from a 300 mg. source of radium+beryllium were used for irradiating 500 ml. of bromobenzene (i) with and (ii) without an electric field of nearly 100 volts per cm. The changes in the relative concentrations of free radicals were studied by measuring corresponding changes in the magnetic susceptibility (ψ) by the Quincke's method employing a magnetic field of 4000 Oersteds.

The target material (C_6H_5Br) is diamagnetic, whilst the free radicals (Br and C_6H_5), and the ions (Br^+ and Br^-) add to the para and diamagnetism respectively. The observed changes in the liquid meniscus (a) -1.5 , (b) -2.5 and (c) -0.3 mm. respectively for (a) unirradiated, (b) irradiated (without) and (c) with electric field, suggest an approximately 2 : 1 ratio for the ions to the free radicals. A possible mechanism is postulated for the corresponding secondary reactions following the (n, γ) recoil process.

Section IV, Chemistry

1. Turbidimetric method of determination of chloride in brackish water.

J. C. CHAUDHURI and A. D. PUROHIT, Jodhpur.

A turbidimetric method of chloride in brackish water of Rajasthan has been described. The suspending medium for the $AgCl$ is 1 : 1 glycerol containing 10% d-glucose (sp. gr. 1.180 at $15.5^\circ C$). Maximum concentration of chloride that can be directly determined by the method is 104 ppb as $NaCl$.

In aqueous solution, $AgCl$ precipitates when the concentration of $NaCl$ goes beyond 25 ppm. Consequently the aqueous solution can only be used below this limit for turbidimetric study. Highly concentrated solution e.g. the brackish water, would need large dilution if this method is to be used. For example, the salinity in brackish water varies over wide range, as experimentally found, in certain regions of Rajasthan between 500 to 10,000 ppm. The results show that for determination of 10^3 ppm of $NaCl$, no dilution is necessary and for $NaCl$ of 10^4 ppm, only ten times dilution would be sufficient by the new method. If a sample of 10^4 ppm $NaCl$ is to be determined by the aqueous solution method, the dilution required is greater than 400 and consequently the error will also be high.

Bausch and Lomb Spectronic 20 was used for these experiments. There is no optimum wavelength. $475 m\mu$ was chosen for all experimentations.

A plot of chloride concentration (ppm) against percentage transmission gave a straight line, which can be expressed by an equation $y=61.0 - 5x$, that is, with a slope of $-\tan^{-1}5$. This standard curve enables one to read the ppm of chloride

as given in the graph and the actual chloride concentration is found out by using the formula, derived in this connection namely,

$$Y = \frac{10 A.X}{V}$$

where Y=Actual conc. of chloride as NaCl (ppm) in brackish water

A=No. of times of dilution that has been made of the original brackish water

X=ppm of chloride as NaCl read from the standard curve against percentage transmission

V=Volume of brackish water solution added to the glycerol-glucose solution.

The use of the above formula is involved because the volume of the glycerol-glucose solution together with the brackish water is kept constant viz. 10 c.c. and consequently the volume, V, can vary. V, however, varies between 0.1 and 2 c.c. only depending on the concentration of chloride. Higher the concentration, lower is the volume, V.

Estimations have been made with NaCl, MgCl₂, CaCl₂, and with their mixtures Sulphates and nitrates do not interfere upto conc. of 500 ppm.

The method has been used for determining the salinity of a large number of brackish water samples of Rajasthan, having salinity between 500 to 10,000 ppm.

The results compare well with those obtained by Volhard method.

A large number of determination of chloride of brackish water can be done per day per analyst. The method will be useful where both speed and accuracy are needed.

Section V, Geology and Geography

1. The nature of the clay minerals in the Rajmahal-soils.

S. P. CHATTERJEE, R. LAHIRI and R. BHATTACHARYYA, Calcutta.

The three major physiographic divisions of Rajmahal are: (1) The Gangetic Plain, (2) The Hills and (3) The Median Valley. The 'diera land' of the Gangetic (The Ganga) Plain has new alluvial or diara soil. Beyond the diara land,—towards Rajmahal (south of the Ganga) is a strip of land approximately bounded by the contour lines of 100 feet and 200 feet where the soil is the so-called 'old alluvium'. Along the northern slopes of the Hills, facing the Ganga, there are three other soil types: (A) Lalmati (non-lateritic), (B) Karar, (C) Kewal, each having its own characteristic physical and chemical properties. In the Median valley, there are, again, three other soil types: (I) Lalmati (lateritic), (II) Bindimati, (III) Dhob ujjala. Of these, I & II are believed to be the exposures of the different horizons of an old laterite profile, whereas No. III is of sedimentary origin. The Balsundar is a light loam occurring in pockets near some of the hill streams.

The nature of the clay-minerals occurring in the weathering complex of the rocks which make up the clay fraction of the soils is of fundamental importance in pedological studies—both theoretical and applied. Considering this importance, the clay-minerals in the Rajmahal-soils have been studied from a chemical standpoint and the 'differential thermograms' of the clay-fraction of each of the above soil type have been given and discussed. Also, the approximate proportion in which the different clay minerals (kaolin, illite and montmorillonite) occur in each soil clay have been calculated.

2. Geomorphological features of Pindari Glacier and its environs.

S. C. BOSE, Calcutta.

During the various phases of Pliocene glaciation Himalayan glaciers became very large and descended down to altitudes much lower than the present snouts. Climatic changes as well as the variations in altitude resulting from orogenesis were responsible for the advance of glaciers at various places. Pindari glacier is no exception. The Pindar valley today shows glacial features up to 20 kilometres below the present snout. A very great accumulation of old ground moraine and a large lateral moraine standing like a ridge, prove clearly the great magnitude of the past glacier. Recent observations confirm slow contraction.

3. The Naga Problem : A geopolitical Analysis.

R. N. P. SINHA, Patna.

The Naga problem of India represents a complex of many problems—the problem of tribal uprising, of cultural assimilation, of national cohesion, of territorial integration and of north-east frontier protection; all these arising from the peculiar physical environment which has moulded the human and economic geography of the region, and the spatial relationship which has made the area strategically significant.

Historically, Naga area was a component part of the vast Indian homeland even before the arrival of the Indo-Chinese tribal groups now known as the Nagas, but it is also a fact that the area was not fully controlled by the Indian rulers right from the past through the times of Mahabharat, Harsha, Ahoms, and the Muslims to the British.

The reasons are anthropogeographic. The rugged terrain, hot humid climate, soft soil, inhospitable forest cover and the resultant communication difficulties kept the area isolated and difficult to be subjugated. Ethnically and linguistically slightly different, the war-like Nagas kept their tribal culture intact and developed a war psychosis against any Indian rule.

Nevertheless, the Aryan cultural influence is reflected in the 'Mithan' sacrifice among the Ao Nagas similar to the Vedic 'Sheel-Gavya' sacrifice. During the British period they came into contact with the British administration and Christian missionaries who fostered in them a sense of being non-Indians and warned them of the so-called danger of 'Hinduisation', becoming more active on the eve of Indian independence. The partition of India, grant of special status to Kashmir and the activities of the Chins, Karen etc. in the neighbouring Burma might have been other motivations.

But in multi-racial, multi-lingual and secular India the demand for a separate State of Nagaland is meaningless. Being deficit in food and capital resources for modern development, the State will not be economically viable. And above all, the geostrategic conditions, especially in view of the Chinese eye on the NE frontier, compels India Government to control the area more effectively, but in co-operation with the Nagas.

4. The Naga Problem : A Geopolitical Analysis.

R. N. P. SINHA, Patna.

The Naga problem presents a complex of a number of problems: problems of tribal uprising, of cultural assimilation, of national cohesion, of territorial integration and of north-east frontier: all arising from the peculiar physical

environment, which has moulded the human and economic geography of the region, and the spatial relationship, which has made the area strategically significant.

Politico-historically, though not fully integrated the area has always remained a component part of the Indian homeland, whether during the Mahabharat times before the arrival of the Tibeto-Burmese speaking Indo-Chinese tribes, the Nagas, during the beginning of the Christian era, or after, during Harsha, or the Ahoms or the British.

But the anthropo-geographic peculiarities have always worked against complete assimilation. The British administrators and Christian missionaries exploited the ethnic and cultural individualities of the Nagas and fanned their tribal and religious feeling against India, especially on the eve of their departure. Their cultural affinities with the Aryans reflected in some of their rituals such as the likeness of the Ao Nagas' 'Mithun sacrifice' to the Aryans' 'Sheel Gavya' sacrifice, were ignored. Difficult terrain, thick humid forest and consequent inaccessibility made the area ideal for guerilla activities. Acquisition of arms during the World War II, the formation of Pakistan, grant of special status to Kashmir and the agitation of Karens and Chins on the Burmese side of the frontier gave them further impetus.

However, the economic inviability and the strategic location of the area in relation to the neighbouring States suggest that the interests of the Nagas will be served best with India which is multi-lingual, multi-racial, secular and tolerant; and not in an independent Christian Nagaland.

5. Change in the Drainage Pattern in Middle Mountainous Country of Orissa.

DR. B. N. SINHA, I.I.T., Kharagpur.

The mountainous region of Orissa is a part of the Indian Peninsula with an initial slope from west to east, prior to the upliftment of the Eastern Ghats and the drainage channels were 'consequent' in type which followed the grain of the country. The old maturely dissected surface along the Eastern coast of India stretching from Chota Nagpur Plateau upto Madras underwent a tectonic upliftment (upto 300 metres) subsequent to the Lower Gondwana deposits to the South West of Cuttack during the Permo-carboniferous period. All the major rivers of Orissa could maintain their west-east courses as they have cut through the 300 metres contour line.

This deeply eroded plateau along the rejuvenated long profile also underwent two other crustal upliftments which elevated the surface to 600 and 900 metres in two stages. This resulted in a sharp watershed in the heart of Orissa which beheaded the Budhabalanga, Subarnarekha, Rushikulya, the Vamsadhara, and the Nagavali but the Mahanadi and Brahmani could maintain their original west-east flow. The tributaries of Mahanadi like the Ib and the Tel and the Sankh and Koel of Brahmani came into existence on the western slopes of the Eastern Ghats with either South West—North East or North East—South West courses which captured the head waters of the beheaded rivers.

It appears that the upliftment of the Eastern Ghats was completed in three successive stages or there was a sufficiently longer interval between the last two upliftments.

This has been suggested by taking cross sections along the interfluvies of the major rivers and at right angles to the present drainage channels. All the cross sections reveal the well developed accordant summit levels at 900, 600 and 300 metres. The beheading of the rivers can also be linked up with not only the elevations of their beheading but also with the stages of upliftment.

A study of the mouths suggests their abnormally big sizes, compared to their present catchment areas and precipitation in case of beheaded rivers. If the main streams of the beheaded rivers are hypothetically projected in their upper reaches they roughly coincide with the general trend of the drainage pattern beyond the Western slopes of the Eastern Ghats.

Further work is essential for the final conclusion of the supposition. It has been suggested in the discussions that Geological studies are essential, either to prove or disprove the above proposition.

6. Relation of Atomic Constitution to Lattice Parameters in some Hornblendes from the Black Hills, South Dakota.

BIMALENDU RAYCHAUDHURI, Calcutta.

The study concerns six hornblendes separated from samples of amphibolite occurring as irregular masses enclosed in pelitic schists in which three zones of progressive metamorphism can be recognised. Two samples come from the lowest part, one from the upper middle part and two from the uppermost part of the garnet zone. The sixth sample comes from well within the staurolite cone. The complete wet chemical analyses and structural formulae calculated from the analyses, for the six hornblendes are given. All the hornblendes are classified as femaglastingsite.

'a sin β ', 'b' and 'c sin β ' of each of the six hornblendes were determined from powder patterns using reflection (600) for 'a sin β ', (0, 10, 0) for 'b' and (002) for 'c sin β '. The powder work was done with a Norelco geiger counter x-ray diffractometer; the experimental conditions and range of possible errors are discussed. Accepting certain reasonable assumptions, the data suggest that, qualitatively at least, substitution of Fe^{2+} for Mg^{2+} in the octahedral site and the substitution of Al^{3+} for Si^{4+} in the tetrahedral site result in a regular increase in the size of 'a' and 'b' while 'c' is practically unaffected by these substitutions. The substitution of Al^{3+} for Mg^{2+} in the octahedral site probably causes a decrease in the size of 'b'. The results are similar to those found by H. H. Hess in his studies on orthopyroxenes of the Bushveld type.

Section VI, Botany

1. Inter-variatal variation in Chromosome pairing in cultivated roses.

M. L. SHAHARE, and S. V. S. SHASTRY, Delhi.

Determination of the chromosome numbers and the study of meiosis were undertaken in 96 varieties of cultivated roses. There is a regular bivalent formation in diploid varieties. In 56 tetraploid varieties of hybrid teas, a tendency for the formation of 14 bivalents was evident in 50 of them. The mean pairing in remaining 6 varieties is around 9-11 bivalents and 6-10 univalents. In 5 of these varieties, relation of univalent frequency with unequal bivalents was discussed. It was concluded that the cultivated roses are subjected to chromosome structural differentiation, and they differ greatly in meiotic behaviour. The main support for these univalents not owing their origin to differences in genomes of original parents is due to potentiality complete pairing in other varieties of the same origin, due to complete pairing at diploid level between the species involved in the origin of the hybrid teas, and because of their association with the occurrence of unequal bivalents.

2. Natural and artificial tetraploids in the genus *Oryza*.

S. SAMPATH, Cuttack.

The genus *Oryza* has been inferred to be of polyploid origin but the cultivated rice having the chromosome number $2n=24$ can be treated as diploid. Some wild species, e.g. *O. latifolia*, *O. cichingeri* and *O. malampuzhensis* have the corresponding tetraploid chromosome number. The prevalence of tetraploids in nature is a challenge for the synthesis of fertile, cultivable tetraploid rices.

Autotetraploids of rice are easy to produce, are stable and show semisterility as well as increased sizes of spikelets. Due to low productivity, these cannot be used for cultivation. The factors controlling semisterility are inferred to be physiological, genic as well as chromosomal. Experiments are in progress to reduce sterility and to reduce frequency of quadrivalents in artificial tetraploids, by synthesis of allotetraploids, by selection and by use of ionising radiations.

The natural tetraploids are being studied for guidance in this project. The tetraploids *O. latifolia*, *O. cichingeri* and *O. malampuzhensis* closely resemble the diploid species *O. officinalis* and have been shown to have one genome homologous with that of *O. officinalis*. These tetraploids do not show increase in spikelet size over the corresponding diploid. Detail of cytology, distribution and interrelationship of these species suggest experimental procedures for synthesizing fertile tetraploid.

3. A Cytological approach to the cause of Triploid Sterility.

J. YANNKY—WILSON, Ghana.

The problem of high sterility in triploids is well-known since it is easily observed in practice. Most explanations of the cause have been genetical but a cytological follow up would be most welcome. But so far cytological observations have shown that in triploids the extra (n) chromosome complement per pollen mother cell is shared between the two daughter nuclei at Anaphase I in various proportions over and above the division of the basic diploid chromosome number. The movement of the chromosomes is at random so that when the daughter nuclei separate after Anaphase II the grains are produced with approximately binomial frequency distribution of the chromosome classes ranging from n to $2n$ chromosomes.

This has been studied in maize, *Solanum*, *Narcissus*, *Petunia* and tomatoes, and the data thus obtained only give the impression that the formation of a fertile triploid depends on the fusion between pollen and ovule of complementary chromosome numbers i.e. n to $2n$ or $n-1$ to $2n-1$ etc. It is true that the chances of such complementary chromosome numbers mating are not terribly high, but they cannot account for the scale of sterility observed in practice.

One way of looking for the answer to the problem lies in observations on the particular chromosomes which make up the chromosomes in the pollen grains and the ovules. But there are not many suitable species in which all the individual chromosomes can be distinguished, such as in *Crepis*, maize and *Aronia*. My recent studies of the Bluebell, *Endymion nanscriptes* (L.) Garcke have added this to the above list of species with all the chromosomes distinguishable, and was used in the studies envisaged.

68 pollen grains were studied at Pollen mitosis I and all the chromosomes in each grain identified.

One of the discoveries that emerged from this study was that some of the grains are not pure but either contain all of the 3 of a particular chromosome (triplicates), or have missing all the 3 of a particular chromosome (incomplete grains).

The triplicates were more numerous than the complementary incomplete grains;—this supports the genetical idea that duplications are not as deleterious as deletions.

The satellitic chromosome was always present in each pollen grain at least once. This may mean that its absence may be deleterious.

Conclusions: The presence of impure grains decrease the chances of proper fertilization since these can lead to the formation of tetrasomic or nullisomic triploids. Further the chromosomes involved in 'triplicates' do not seem to have their complementary incomplete grains, and also the triplicates are far more numerous than the incomplete grains.

Hence the greatly reduced chances of the correct fertilization offer a true triploid, and the resultant sterility in triploids.

Ref. Cytologia 24 (4) 466-477. 1959.

Section VII, Zoology and Entomology

1. Normal Spermatogenetic cycle of Indian salientia.

J. L. BHADURI, ASIT MONDAL and S. L. BASU, Calcutta.

Spermatogenetic cycle in Salientia is an ever fascinating problem in the field of reproductive physiology primarily due to its seasonal variation. Valuable reports have been obtained in the field of research involving particularly the frogs and toads inhabiting cold and temperate climates although there have been sporadic observations on the male gonadal cycle of tropical Salientia also. But in all these species except *Rana temporaria* neither any systematic observation throughout the year nor any quantitative evaluation on spermatogenesis has been made. Consequently, we tried in our laboratory with a precise and meticulous way, as mentioned above, to find out the annual male reproductive cycle of *Bufo melanostictus* and *Rana tigrina*.

For the sake of convenience, we have divided the whole process of spermatogenesis into six different stages starting from primary spermatogonia in the resting condition till the spermatid formation. Moreover, the stages were also characterised by the number of cells in a cell-nest and by some specific cytological details.

In *Bufo melanostictus* there is almost a gradual and steady increase in the relative testicular weight from the month of September and reaches the maximum in the month of June. The tubule diameter is narrow and is more or less constant throughout the year. Primary and Secondary spermatogonial number increases from August till October—November and then a gradual decrease is noted. Advanced secondary spermatogonia and Primary spermatocyte are most frequent in the tubules all throughout the year. Spermatids are more frequent in the tubular lumen and they are predominant numerically from October through January. Sperms are present all throughout the year both in scattered and in bundled form.

In *Rana tigrina* the relative testis weight and the mean seminiferous tubule diameter are directly proportional to each other. The increase in the testicular weight is noticed during January through May-June, and then a gradual decline is observed. The sperms and higher spermatogenetic stages are either few or absent during the winter months. It is interesting to note that the spermatogonia and spermatocytes generally predominate during winter months when spermatids and sperms are absent (if present they are in a degenerating condition). But in summer all dividing stages of the spermatogenetic cell-nests are present. As soon as the temperature decreases further progress of sperm formation is checked.

From the previous reports various types of spermatogenetic cycle in Salientia may be grouped into three categories, e.g., CONTINUOUS, POTENTIALLY CONTINUOUS, and DISCONTINUOUS types. Thus from the above observation it appears that the annual cycle of *Bufo melanostictus* is a continuous one while that of *Rana tigrina* is potentially continuous.

2. Effects of Testosterone on the Spermatogenesis of frogs.

S. L. BASU, Calcutta.

Several investigators have tried to elucidate the effects of testosterone on the male gametogenesis in some higher vertebrates. But our knowledge is utterly inadequate at present about the testosterone—spermatogenesis correlation in Salientia. During last few years some reports appeared regarding this steroid action on the spermatogenesis of *Rana temporaria* (van Oordt and Basu, 1959, 1960) and *Rana esculenta* (van Oordt and Schouten, 1961) of Europe. In both the above mentioned species it is conclusively proved that testosterone appears to cause complete inhibition of the multiplication division of the spermatogonia and thus prevents the strong increase in spermatogenetic activity.

With a view to compare the testosterone action on the spermatogenesis of temperate and tropical Salientia, a group of common Indian frogs, *Rana tigrina* was treated with testosterone in the form of hypodermic pellets during last summer with adequate controls. It is observed that within four (4) weeks time a complete inhibition of the spermatogenetic activity takes place. Moreover, the histoarchitecture of the treated and control testes of *Rana tigrina* further reveals that the action of testosterone in this tropical frog with potentially continuous spermatogenesis is more intense within this short span of treated period. The results obtained in the present experimental material is compared with other species of frogs of the temperate zone. The mode of action of testosterone and its probable role in the regulation of the spermatogenetic cycle is also discussed.

3. On the breeding of major Indian carps by the injection of pituitary gland hormone.

J. C. ROY, and R. K. DAS, Orissa.

1. Thirty sets of experiments were conducted on the breeding of *Cirrhina mrigala*, *Labeo rohita* and *L. calbasu* by the injection of Pituitary gland hormone of catfishes, major carps and mullets at Kausalyaganga, Balasore, Kathipal, Sambalpur and Sonepur.

2. In 25 sets of experiments which were successful, 16 experiments were with catfish glands with a percentage of hatching between 10 and 90, 9 experiments were with carp gland, with a percentage of hatching between 50 and 99.

3. Single injection led to breeding in 6 cases, double injection in 16 cases and triple injection in 3 cases.

4. Breeding took place between water temperature of 26.8°C to 29°C but only in one case it occurred at 30°C.

5. In 3 sets where there was no spawning, the water temperature was 30°C and above. In another case, spawning did not take place, possibly as the breeder was not ripe Mullet pituitary gland, preserved for 9 months having been administered in another set, did not result in spawning.

4. On the vocal sounds of snakes.

B. K. BEHURA, Cuttack.

The hissing sound of snakes is a respiratory act. In the cobra, the throat is turned into a sort of pouch and the sound 'fohn' is produced both during inspiration and expiration. In the bull-snake (*Pituophis*) of North America which produce a loud hissing sound, the air strikes against a fleshy flap rising in front of the opening to the wind pipe. Hissing is usually combined with the inflating and flattening of the body. A review of the few recorded cases of snakes producing sound other than hissing is made. The pythons (*Python molurus*) and the dhamans (*Ptyas mucosus*) under duress or when alarmed produce sound which resembles a long drawn out 'oomh' of a child disturbed at play or of a man in agony. The banded krait (*Bungarus fasciatus*), the dhaman and the *Boodon lineatus* of Sudan produce various kinds of sounds other than hissing and 'oomhing'.

5. Studies on the arterial system of the common Indian toad, *Bufo melanostictus* Schneider. 1. The occipitovertebral artery.

PRIYAMBADA MOHANTY, Cuttack.

In the common toad, *Bufo melanostictus* Schneider, the occipito-vertebral arises near the subclavian artery from the inner border of the systemic arch. It runs forwards giving rise to a *pharyngeal* artery supplying the pharynx and continues anteriorly close to the internal carotid artery. It gives out a small *muscular* artery supplying the muscles of the dorsal side. It then penetrates the dorsal muscles and bifurcates into two, a *vertebral* artery running at right angles to the other, the *occipital* artery. The vertebral artery enters the vertebral column. The occipital artery continues to run dorsally and emerges out posterolateral to the cranium and the occipital region. The occipital continues along the outer edge of the fronto-parietal of the side and gives out an *optic* artery which supplies the orbit and the eye. The occipital artery continues further anteriorly, then bifurcates into two, the *olfactory* artery entering the nasal sac and the *cranial* artery entering the brain at its anterior end.

6. An analysis of the food of the Grey Quail (*Coturnix coturnix* Linnaeus) of Western Rajasthan (India).

AJIT KUMAR MUKHERJEE, Calcutta.

The present paper deals with the results of investigation about the food habits of the grey Quail, (*Coturnix coturnix* (Linnaeus) in Western Rajasthan. The author analysed the gut contents of 21 specimens collected from Nagpur, Jodhpur and Jaisalmer Districts during the winter, spring and summer of 1957 to 1960. Most of the birds were collected from near-about cultivated fields of millets.

The analysis revealed that the birds are more or less dependent on vegetable matter (approximately 90 percent) of which about 72 percent consists of tender leaves, flower buds and weed seeds of mostly wild grasses only, and 18 percent of seeds of cultivated grains. The animal food is about 8 percent composed of spiders and some insects of agriculture importance. In conclusion the bird could hardly be accused, at least in Western Rajasthan, to be economically harmful against the general belief that it robs seed grains, oil seeds and pulses from standing crop and farms.

Section VIII, Anthropology and Archaeology

1. Notes on the method of studying rural society.

SURAJ BANDYOPADHYAY and KUMARANANDA CHATTOPADHYAY, Calcutta.

1. This study is concerned with how to derive a normative picture of any rural society as a whole. It is divided into three parts, viz. (a) the method, (b) the frame-work and (c) an illustration from the analyses of 439 villages having 26,173 households and a population of 1,44,951 surrounding Giridih Town in the district of Hazaribagh, Behar.

2. The study advocates a particular method termed here as "homogeneity method" which if followed seems to minimise the survey units in order to curtail the all-round cost of the same without sacrificing any important data in this respect.

3. In the frame-work, the writers have chosen six different societal attributes for determining the homogeneity of villages. These are (1) Community, (2) Religion, (3) Caste structure, (4) Industry, (5) Occupation and (6) Location or place of work of rural folks.

4. The next part of the study deals with the analyses and distribution of several hundred villages of a particular area under three physical attributes, namely, (i) Town distance, (ii) Bus distance and (iii) village size.

5. In the concluding portion the writers have shown the importance of physical attributes for isolating the homogeneous villages in order to facilitate the above mentioned study. They have also stressed that, as the present study is an exploratory nature in the sense that it is restricted to a particular area, so no rigorous inference should be drawn from this study. They hope, however, that other scientists will apply this method to their respective fields and will thereby help in arriving at a scientific generalization in this regard.

2. The Incubus of Ethnic Evolution and its impact on National and International Integration.

JAL F. BULSARA, Bombay.

In the world as we find it to-day, there are 90 nations who are members of the United Nations Organisation, and there are about ten nations who have not been admitted to the U.N.O. for various reasons. There are more who are under colonial rule. Hardly five of these form single or unmixed ethnic or linguistic groups. Among the smallest nations, there are, inter alia, dialectical, ethnic, or tribal groups, who claim individual existence or special facilities and privileges. A few countries like Switzerland and the United Kingdom have succeeded in stabilising their internal minority group relations, but a majority of the nations of the world cannot be said to have done so. Friction wells up among them periodically and is an obstacle to unity of action towards progressive national development. The object of the Paper is to probe into the formative factors of ethnic evolution and to study the historical causes of group antagonisms, with a view to see how they could be removed or obviated as obstacles to national unity and international cooperation.

Section IX, Medical and Veterinary Sciences

1. A case of Chronic Seborrhoea treated with tissue therapy.

D. K. RAY, Calcutta-37.

Tissue therapy was tried with success in a case of chronic seborrhoea with corrugated hyper keratosis of skin in an old man aged 50. Course of 30 injections of tissue extract was given daily. Progressive improvement was noticed throughout the course of treatment. The affected areas looked absolutely normal one month after the course of treatment was over.

2. The amino acid composition of Trichomonad Protozoa.

KRISHNA N. MEHRA, Nainital.

Paper electrophoretic studies of the hydrolysates of *Tritrichomonas foetus*, *Tritrichomonas suis*, *Trichomonas gallinarum*, *Trichomonas gallinae*, *Trichomonas hominis* and *Paratrichomonas* sp. from pig rectum revealed the presence in all species of aspartic acid, glutamic acid, arginine and/or lysine. One band which migrated relatively little might have contained several amino acids. An unidentified band which migrated beyond the fastest basic amino acid was also present. In an unhydrolyzed *T. foetus* extract, glutamic acid and arginine and/or lysine, two bands similar to those in the hydrolysate, were identified. Unidimensional paper electrophoresis was not found to be a satisfactory method for the separation of amino acids. The electrophoretic patterns of the 6 species studies looked the same and it was not possible to distinguish one species from another.

Aspartic acid, threonine, serine, glutamic acid, glycine, alanine, valine, isoleucine, leucine, tyrosine, phenylalanine, histidine, lysine and arginine were found and their amounts determined by column chromatography in the hydrolysates of *T. foetus*, *T. suis*, *T. gallinarum*, *T. gallinae* and *Paratrichomonas* sp. Aspartic and glutamic acids were highest in amount in all species. The lowest in all species was histidine. Proline was present in all species but in an amount too small to be studied quantitatively. An unidentified compound which emerged from the column later than arginine was found in all species. In addition to the above amino acids, cystine, cysteine and methionine may have also been present in amounts too small to be detected. There were some differences in the quantities of different amino acids in the various species, and it is possible that trichomonad species may be identified on the basis of the amounts of amino acids which they contain.

3. Avian Salmonellosis: An outbreak of egg-peritonitis simulating *Salmonella Pullorum* infection caused by *Salmonella Stanley*.

S. S. KHERA, S. B. V. RAO and K. K. AGARWAL, Mukteswar-Kumaon.

An outbreak of avian salmonellosis caused by *Salmonella stanley* is described. In the laying birds which were chiefly affected, the disease was characterised by necrotic lesions in the ovaries. The lesions often progressed to generalised peritonitis. *S. stanley* was invariably isolated from the lesions of affected birds. The treatment of birds with certain drugs of proven efficiency such as Nitrofurazone and Furazolidone was of no avail and the disease was controlled by segregation and destruction of serological reactors, and immunisation of other birds with a vaccine prepared from the isolated strain of salmonella.

4. Studies on (a) pathogenesis of *Brucella Abortus* infection in Guinea Pigs. (b) pathological changes in the lymphoid organs and correlation of serological response with the plasmocytic reaction.

P. RAMA RAO, S. S. KHERA and G. L. SHARMA, Muketswar-Kumaon, U.P.

Clinical observations and the progress of pathological changes in the spleen and lymph nodes of 40 *Br. abortus* infected guinea pigs sacrificed at different post-infection intervals have been described.

The infected animals had shown a mild low grade temperature reaction, low weight gains and gradual loss of condition. Microscopic changes, apart from characteristic surface granulation seen in the spleen from 16th day onwards, were negligible. The microscopic changes in the spleen which were most pronounced on 20th and 24th days, were characterised by lymphoid hyperplasia and necrotic changes in the lymphoid follicles, reticular hyperplasia in the splenic cords, cellular engorgement of sinuses, epithelioid and giant cell formation both in the white and red pulp and formation of abscesses occasionally. In the lymph node the changes were essentially similar to those observed in the spleen but tended to develop later and were relatively more pronounced.

A close correlation was observed between the serum agglutinin titre and the plasma cell reaction in the lymph node throughout the course of infection.

5. Studies on (a) pathogenesis of *Brucella Abortus* infection in Guinea Pigs. (b) the distribution of Brucellae in the body tissues after intravenous inoculation.

P. RAMA RAO, S. S. KHERA and G. L. SHARMA, Muketswar-Kumaon, U.P.

After intravenous inoculation of 9.08×10^8 organisms of *Br. abortus* strain 544 in male and pregnant female guinea pigs, it was found that the primary bacteraemia lasted for about 48 hours and the blood was not infective on the 4th day. During first few hours the number of organisms gradually increased in the spleen, lymph nodes, liver, lungs, kidneys and testis or uterus. Although the infection was sustained in all of the organs tested, except kidneys, up to the study period of 35 days, progressive increase in the number of organisms occurred only in the lymph nodes and testis in males and uterus in females. Secondary bacteraemia occurred about the 20th day.

6. Studies on pathogenesis of *Brucella Abortus* infection in Guinea Pigs. and pathological changes in the uterus, testis and some other organs.

P. RAMA RAO, S. S. KHERA and G. L. SHARMA, Muketswar-Kumaon, U.P.

The progress of *Br. abortus* infection was followed in forty guinea pigs which were killed at intervals of time upto 56th day.

In the pregnant females the congestion of maternal sinuses and placenta was followed by inflammatory and suppurative necrotic changes in the maternal decidua and junctional zone of trophoblast. Secondary abscesses were seen in the labyrinth on 24th and 35th days of infection.

In the non-pregnant animals the uterine wall showed pronounced leucocytic infiltration particularly around the uterine glands many of which contained suppurative exudate. Small microscopic abscesses were seen in the myometrium occasionally.

In the males, in the testis degenerative changes in the seminiferous tubules were most pronounced on 12th and 16th days. Abscess formation was encountered only occasionally in the epididymis but never in the testis.

In the liver leucocytic infiltration in the portal areas and in the lobules was noticeable from 4th day onwards. After the 8th day changes were characterised by granuloma formation in the portal areas and small necrotic foci in the parenchyma which involved both Kupffer cells and the hepatic cells.

In the lungs thickening of lobular and alveolar septa owing to the proliferation of septal cells and infiltration of mononuclears was most pronounced about the 35th day of infection.

In the kidney and adrenal the changes were relatively mild and retrogressive. In the kidney the tubular cells both in the cortex and medulla showed degenerative changes. In some animals renal corpuscles showed thickening of Bowman's capsule and disintegration of glomeruli. In the adrenal mild degenerative changes in the cortical cells were accompanied with diffuse mononuclear infiltration.

7. Studies on post partum oestrus in Murrah buffaloes.

S. N. LUKTUKA and D. J. ROY, Izatnagar, U.P.

Studies have been conducted on post partum oestruses in buffaloes belonging to the experimental Murrah buffalo herd of the Indian Veterinary Research Institute, Izatnagar.

It was found from 123 post partum periods that the first oestrus appeared on an average 115.58 ± 7.10 days following parturition. The interval between parturition and conception was found to be 149.36 ± 7.40 days. The first post partum oestrus was not always ovular. The incidence of anovular oestrus was found to be 5.7 per cent. In 18 cases the corpus luteum was detected though the animals had not showed any signs of oestrus post partum. The incidence of silent oestrus worked out to be 14.6 per cent. The intensity of heat at first post partum oestrus was normal in 80.0 per cent, weak in 18.1 per cent and pronounced only in 1.9 per cent cases. Inseminations were done at the first post partum oestrus in 105 cases out of which 62 (59.0 per cent) conceived. Animals which repeated were inseminated at subsequent heats. Overall pregnancy rate worked out to be 1.60 A.I./conception.

8. Relative efficacy of different buffers for the preservation of buffalo semen.

U. D. SHARMA and S. C. MAHAJAN, Izatnagar, U.P.

The experiment was designed to assess the comparative efficiency of some of the most commonly employed semen diluents namely, yolk-phosphate, yolk-citrate, yolk-boiled milk, yolk-glycine and yolk-glucose-bicarbonate dilutors. 12 semen samples from nine buffalo bulls were diluted at 1:10 and 1:50 levels of dilution. Yolk-glucose-bicarbonate diluent was found to be significantly superior to the other diluents compared in this experiment. The average number of days, the sperm survived in this diluent were 16 and 12 days at dilution rates of 1:10 and 1:50. The average number of spermatozoa surviving after 10 days of storage were 22 and 8 per cent at low and high dilution levels respectively. From the results of this investigation, it is concluded that buffalo sperm can possibly be preserved in yolk-glucose-bicarbonate diluent for at least 3-4 days with desired motility rating for A.I. use provided the dilution rate of semen is not high. At higher levels of dilution, agents effective against harmful effects of dilution should be incorporated.

9. Preservation of buffalo semen. III. Role of seminal plasma IV. Effect of potassium ions in yolk-glucose-bicarbonate diluent.

U. D. SHARMA and S. C. MAHAJAN, Izatnagar, U.P.

Preservation of semen from buffalo bulls of 'local type' revealed that :

(i) Centrifugation of buffalo semen was harmful for the subsequent preservation of spermatozoa.

(ii) The addition of seminal plasma to the centrifuged semen helped in part to overcome the harmful effect of centrifugation.

(iii) There was an indication that the addition of five parts of isotonic KCl solution (1.15 per cent) to 95 parts of glucose-bicarbonate buffer had some beneficial effect against dilution on preservability of buffalo spermatozoa.

(iv) Potassium bicarbonate buffer was superior to sodium bicarbonate buffer but the differences failed to be significant.

10. Some observations on preservation of buffalo semen in the Illini Variable Temperature diluent.

U. D. SHARMA and S. C. MAHAJAN, Izatnagar, U.P.

The preservation of semen from three buffalo bulls in the Illini Variable Temperature (I.V.T.) diluent showed that the spermatozoa survived better in an air-conditioned room (22-30°C) than at room temperature (18-30°C) or in a refrigerator (4-6°C). At room temperature (18-29°C) spermatozoa survived better in I.V.T. diluent containing ten per cent egg yolk than in the diluent with no egg yolk. There was special advantage in using sulphamezathine instead of sulphanimide in the I.V.T. diluent at room temperature.

11. Cases of seborrhoea with secondary infections in Children cured with Tissue Therapy.

D. K. RAY, Calcutta.

Six cases of seborrhoea with secondary infections in children was tried with tissue therapy with success. Water extract made from treated Neem leaves was administered orally for 25 days to get a full recovery. It is nearly a year now and recurrence does not seem to have occurred.

12. Lepromatous Leprosy treated with Tissue Therapy.

D. K. RAY, Calcutta.

Tissue therapy was tried for the first time in the cases of Lepromatous type of leprosy in human beings. Considerable bacteriological improvement was noticed after the 18th injection. Further improvement was noticed after 30th injection in the reduction in number of bacilli per field as well as in the number of globus forms in the major part of the smear. Trial is now on in the same patient with tissue implantation (Ray, 1950) as well as a course of tissue extract injection.

13. Tissue therapy in a case of Maculoanaesthetic type of leprosy with Trophic Ulcers.

D. K. RAY, Calcutta.

Implantation of skin of heterogenous origin followed by a course of Tissue extract injection is being tried in a case of Maculoanaesthetic type of leprosy with trophic ulcers in a woman aged about 35. Result obtained so far is very encouraging. Trophic ulcers have completely healed up with 25 injections given on alternate days. The patient has a feeling of general well being and rapidly improving in health. A total of 45 injections will be given in the first course. The treatment may have to be repeated after some months and three such courses have to be given before anything definite could be said about the efficiency of this therapy in leprosy of this type.

Section X, Agricultural Sciences

1. Experiment on Polyethylene Mulching.

K. SENGUPTA and M. K. DAS, Kalyani.

Polyethylene film has been widely used for agricultural purpose in U.S.A. and other countries over last few years.

The black Polyethylene film is well suited for mulching purpose. It is flexible and can be spread over the ground. During the rainy season, it prevents rains from compacting the soil. It also prevents evaporation of moisture from soil. Since evaporation of moisture is prevented to a great extent, crop can be raised with fewer number of irrigations. The black film also prevents weed growth and therefore, the cost of weeding is reduced to a great extent.

An experiment was conducted at the Seed Multiplication Farm, Fulia to find out the effect of Polyethylene mulching on the yield of Cauliflower. Treatments were (i) Control, (ii) Planting on flat bed and immediately mulching with Polyethylene and earthing up after three weeks, (iii) Planting on ridges and immediately mulching with Polyethylene—earthing up after three weeks. The yields obtained were 200 mds per acre for control, 312 mds. per acre under treatment (ii) and 355 mds. per acre under treatment (iii).

Experiments are also under operation on crops like Brinjal, Jute and Maize.

2. Studies on Liming of Acidic Red Loam Soils I.—Response of Crops to Liming.

S. C. MANDAL, H. SINHA, C. R. PRASAD and M. A. ALI, Ranchi.

Acid soils are found extensively in six out of seventeen districts of Bihar, covering four to five million acres. A precarious crop of paddy is grown in these soils, interspersed with the millet crops *marua* and *gondli* and the pulse crop *rahar*. These acid soils are of poor fertility with low contents of calcium, nitrogen, phosphorus and organic matter. They respond to fertilisers and the yield of paddy can be pushed up from 3 to 5 mds./acre to 7 to 8 mds./acre only. Upland crops e.g. maize, *juar*, cotton, soyabean, *mung*, groundnut etc., fail to grow well and yield a reasonable quantity even after normal supply of N, P, K fertilisers to the soil. Acidity being the principal limitation of the productivity of these soils, a series of experiments with lime were conducted at Kanke farm during the years 1958-61 in two plots of soil reaction pH 5.3 and pH 5.4 respectively. A number of crops were grown viz., maize, *juar*, soyabean, *rahar*, ground-

nut, cotton, *kalai* (*Phaseolus mungo*), *mung*, *marua*, *gondh*, *surguja* (*niger*), wheat, barley, pea, gram, *masur* (lentil), mustard and linseed. Paddy was not grown as it failed to respond to lime in a pilot experiment conducted during the years 1956-58. Lime was applied according to the lime requirement of the soils, worked out by laboratory equilibrium methods. The increase in yield due to liming varied from 100% in maize and *juar* to 1000% in *rahar*. Crops that respond highly to lime, or the most calciphilic crops, are *rahar*, cotton, soyabean, gram and groundnut. The crops of intermediate lime response, or calciphilism, are maize, *juar*, *kulthi*, *kalai*, wheat, pea and *masur*. Crops that show little or no response to lime are paddy, *marua*, *gondh*, *surguja*, barley and mustard. Cropping should thus be adjusted according to the lime status of the soil. Calciphilic crops should be grown in the early years of liming followed by crops of intermediate calciphilism and the non-responsive crops in the last one or two years in a cycle of five or six years.

3. Studies on liming of acidic red loam soils II.—Dose and Frequency of Liming.

H. SINHA, P. SINHA, M. A. ALI and S. C. MANDAL, Ranchi.

It has been discussed in an earlier paper of this series that application of lime to the acidic red loam soil of Chotanagpur led to great increases in the yields of a number of upland crops. Concurrently, field and laboratory studies were also undertaken to determine the dose and frequency of liming in these soils. Field experiments indicated that for pH 5.7 one ton of lime would be required in lighter soils. Lower doses are not effective as much and higher doses bring about no additional increases in yields. On the basis of laboratory equilibrium studies and those field experiments a tentative schedule for liming has been worked out for three textural classes sandy loam, loam and clay loam. It has been found that for each difference of 0.1 unit of pH the lime requirement changes by about 400 lbs. of lime per acre. Field experiments on the frequency of lime application conducted for five years, proved conclusively that lime should be applied once in five years to the full lime requirement dose of the soil. There is no additional gain in applying lime every season or every year.

4. Studies on liming of acidic red loam soils III.—Placement of Lime.

S. C. MANDAL, H. SINHA, C. R. PRASAD and M. A. ALI, Ranchi.

Placement of fertilisers has engaged the attention of agronomists for a long time. It has also been found by some workers, particularly of Australia, that deep placement of lime is more effective than surface application. An experiment was thus laid out in the acid soil of Kanke farm (pH 5.3 to 5.4) to find out if depth placement or surface-cum-depth placement is more effective than surface application. Gram and maize were grown as experimental crops for three successive years. No beneficial result was obtained from depth placement or depth-cum-surface applications of lime.

5. Studies on liming of acidic red loam soils IV.—The quality and fineness of liming materials.

S. C. MANDAL, H. SINHA, C. R. PRASAD and S. C. LALA, Ranchi.

Field experiments were conducted on a soil low in almost all the major elements and representing a typical upland red loam of Chotanagpur to study the

effects of quality and fineness of liming materials on the yields of maize. Results of the experiment show that all the liming materials were equally effective in increasing the yield of maize. Though the highest increase in yield was obtained with market lime, it was not significantly different from the yields obtained by the application of limestones collected from different sources.

The degree of fineness of liming materials also did not influence the yield of maize. The coarse particles of limestone representing 10 mesh size raised the yield of maize to the same extent as finer particles of 100 mesh size.

Definite conclusions, however, cannot be drawn from one year's experimental results as presented here. The study will continue for two more years. Nevertheless, it is apparent from the existing data that the quality and fineness of liming material have no significant effect on the yield if applied in accordance with the total calcium requirement of the soil.

6. A suggestion as an alternative to the usual Polariscope one in evaluating cane types from sugar point of view.

S. C. SEN, Kanpur.

The use of Hand Refractoor as an alternative and the usual polariscope one was first suggested in India by Khanna and Sen as early as 1934. They worked out a hyperbolic equation $Y = -0.01104 x^2 + 1.484792x - 7.79110$, where y and $x = \text{Pol. \%}$ and Brix $\%$ respectively of bullock crusher juice having about 60% extraction for predicting Pol $\%$ juice from Brix of juice. They also worked out a linear equation for predicting Brix of the stalk juice from middle internodal ref. brix by the equation $y = 0.76m + 3.85$ where $y = \text{stalk brix}$ and $m = \text{middle internodal ref. brix}$.

Since the percentage of non-sugar varies with seasons and also within different periods of the season, it has been thought that probably still better fit would be obtained if two separate equations in place of one second degree equation are worked out. The difficulty lies in drawing this dividing line from consideration of ripening phases. The brix and pol $\%$ juice analysed for the past few years are plotted against each other in a graph to select the dividing line and two regression equations have been worked out statistically one with brix values 16.0 and above for high brix and the other with brix value below 16.0 for low brix. Equations are $y = 1.0486x - 3.527$ for high brix and $y = 1.131x - 5.039$ for low brix, where $y = \text{pol \% juice}$ and $x = \text{brix of the juice}$.

Since a large number of canes clumps are necessary for correct assessment of juice quality, roughly 1/10th of the lot, which is absolutely impossible at least on the spot, but the assessment of cane quality may be easily judged by extracting by hand refractometer and then assessing the pol $\%$ juice from this table.

7. A convenient New Method for the Large-scale Sterile Culture of Higher Plants.

M. M. R. K. AFRIDI, Aligarh.

A simple and reliable technique to grow large batches of plants under sterile conditions is presented here. A 3.5 litre beaker with a small central hole stoppered with a rubber bung through which passes a small glass tube, is kept on a suitable wooden base and is connected with a 3.5 litre aspirator bottle, containing 2.3 litre of nutrient solution, by means of a 3 meter long thick-walled rubber tubing. Each beaker contains 3.4 kilogram of sand mixed with 25-30 gram of $\text{Ca}(\text{CO}_3)$, to check 'ammonia injury' and to supply additional CO_2 . The bung is loosely covered with

some glasswool and on inverted watch-glass. The tops of the beaker and aspirator are covered with dishes, kept in position by means of cotton-wool pads. The apparatus is then sterilised at 121°C for an hour—8 such sets may be sterilised simultaneously in a Slater jacketed steam steriliser.

After surface-sterilisation for 3 minutes with 1% aqueous bromine solution followed by adequate washing, 30 seeds are sown aseptically in each beaker. Normally the aspirator is kept at a level below the beaker and is raised 3 times daily to supply the solution, after the seeds have germinated. Transplantation of separately germinated sterile seedlings gives slightly better results.

The method has proved very useful in nitrogen metabolism studies, requiring strict control of nitrification in the growth medium of experimental plants.

8. Nitrate Reductase Studies in Higher Plants : I. Sources of error in the method of assay and their prevention.

M. M. R. K. AFRIDI, Aligarh.

Two major sources of error occur in the nitrate reductase assay. First, the non-enzymic reaction between reduced diphosphopyridine nucleotide (DPNH) and NO_2 , resulting in the loss of the latter. Medina and Nicholas (Biochim. Biophys. Acta 23 : 440, 1957) proposed a barium-alcohol precipitation method for removing residual DPNH, which was found by the present author to be time-consuming and inadequate when either much phosphate was present or the volume of the reaction mixture exceeded 1 ml. As detailed below, the use of alcohol dehydrogenase (ADH) to oxidise DPNH, thus rendering it unreactive with nitrite, has been found to be very convenient and reliable in preventing the error.

To the reaction mixture containing upto 0.4 mg. DPNH add, at the end of the reaction period, 1.45 mM of acetaldehyde, rapidly followed by about 0.25×10^3 Racker units of ADH, which is available commercially, and may also be prepared from yeast, a fair preparation, yielding about 5×10^4 units of the enzyme in stable form.

The other major source of error in the colorimetric estimation of NO_2 by the Griess-Ilosvay method is caused by precipitation of protein by the acid sulphanilamide reagent. Centrifugation and resuspension of the pellet before colorimetric estimation failed to solve the problem. Several chemical denaturants of proteins were also found unsuitable.

Out of 7 detergents tried only sodium dodecyl (lauryl) sulphate was found to maintain the protein in a clear disperse state, after acidification, without interfering with nitrite estimations. 1 ml. of a 9 mg/ml. aqueous solution of pure sodium lauryl sulphate is sufficient to prevent upto 5 mg. of plant protein from precipitation.

The combined use of ADH and sodium lauryl sulphate is therefore recommended for rapid and accurate assay of nitrate reductase as well as other allied enzyme systems.

9. Nitrate Reductase Studies in Higher Plants : II. The distribution of the enzyme.

M. M. R. K. AFRIDI, Aligarh.

A careful survey of plants of comparable age belonging to 15 different species of common plants grown in sand culture with nitrate as the source of nitrogen, showed that cauliflower (*Brassica oleracea* var. *botrytis*), white mustard (*Sinapis alba*) and vegetable marrow (*Cucurbita pepo* var. *Oulifera*) had the highest activities of nitrate reductase, the activities noted being several times higher than those

reported in soya bean by Evans and Nason (Plant Physiol. 28 : 233, 1953). The activities in the laminae of 3rd to 6th leaves were invariably much higher than those in (1) other leaves, (2) cotyledons, (3) petioles and stems. Spinach and seakale beets (*Beta vulgaris* var *Cicla*) and lettuce (*Lactuca sativa*) showed hardly any activity. Other species that showed consistently low activities included radish (*Raphanus sativus*), water cress (*Rorippa Nasturtium-aquaticum*), rape (*Brassica campestris* var. *Napus*), lucerne (*Medicago sativa*) and spinach (*Spinacea oleracea*), those showing fairly high activities were tobacco (*Nicotiana tabacum*), Mung bean (*Phaseolus radiatus* var. *mungo*), pea (*Pisum sativum*), tomato (*Lycopersicon esculentum*) and Sunflower (*Helianthus annuus*). Of the 6 British commercial varieties of cauliflower tested, Tremendous, and Majestic showed about double the activity exhibited by All The Year Round and 3 to 5 times that of Navo, Early Snowdrift and Lucifer.

In cauliflower and white mustard maximal activities were noted at age 5 to 10 weeks and 3 to 8 weeks respectively.

10. Effect of Plant regulator sprays on Sex, Fruit-set and Fruit Development in Cucumber (*Cucumis sativus* L.)

B. CHOUDHURY and A. V. PATIL, New Delhi.

Plant regulator sprays have been found to modify effectively the sex in cucurbits. Previous work at the Indian Agricultural Research Institute (Choudhury and Phatak, 1959 a, b and c, 1960) and other places (Laibach and Kribben, 1950 a, b and c, 1951, Laibach, 1951; Wittwer and Hillyer, 1954; Ito and Saito, 1956 a and b, 1957) have shown that different plant regulator sprays significantly increase the number of female flowers in cucumber. A study was conducted in 1960 in the Division of Horticulture, I.A.R.I., New Delhi to confirm the previous findings and also to investigate the effect on fruit set and fruit development. The plant regulators used were MH (50, 100, 200, 400 and 600 ppm), NAA (50, 100, 150 and 200 ppm), IAA (50 and 100 ppm), 2, 4-D (2.5 and 5 ppm) and GA (10, 25, 50 and 100 ppm). One set sprayed with distilled water was kept as control. MH at 50, 100 200 ppm, NAA at 50 and 100 ppm, IAA at 50 ppm and GA at 10 and 25 ppm significantly increased the number of female flowers than the control. All the treatments induced the early appearance of first female flower on the main axis. There was a high female to male flower ratio in the treated plants. The fruit set was also increased by plant regulator sprays. MH at 100 to 600 ppm, NAA at 100 to 200 ppm, IAA at 100 to 200 ppm, 2, 4-D at 5 ppm and GA at 10 to 100 ppm significantly increased the fruit set when compared to unsprayed plants. GA treatments brought about quicker development of fruits. The final number of fruits harvested however, increased only in the treatments NAA—50 to 200 ppm, IAA—50 ppm and GA 10 to 50 ppm. The size of individual fruit was not affected though the weight increased on Plants sprayed with MH—25 to 600 ppm, NAA—50 to 150 ppm, IAA—50 ppm and GA—10 to 100 ppm. The final yield of fruits per vine was increased by MH at 50 to 200 ppm, NAA at 50 to 200 ppm, IAA at 50 ppm and GA at 10 to 100 ppm.

11. Behaviour of mango varieties introduced from other States at Sabour (Bihar).

P. C. MALLIK, T. S. N. SINGH and S. PANDAY, Sabour.

Forty-eight varieties of choice mangoes from other States and few from within Bihar had been collected and grown at Sabour under identical condition to assess and compare their suitability in Bihar. After a quarter of a century's study, it

can be safely said that a few of them have come out very successful. These varieties can come in commerce of the State.

The exotic plants have been categorised under different status according to their height and that again classified according to their canopy shape. So some of them can be recommended for beautifying the gardens in front of one, two or more storied buildings. Also, it is now possible to change the spacing in new orchards according to the height and spread of the trees.

12. Cytogenetical studies of some Inter-Generic Hybrids of Sugarcane. *Saccharum officinarum* (var. *vellai*) X *sorghum halepense* (Linn.) Pers. type (var. *Palestine*).

S. GOVINDASWAMI, Cuttack.

The inter-generic hybrids *Saccharum officinarum* (var. *vellai*) X *Sorghum halepense* and the back crosses obtained for getting fodder types were studied. In the F_1 hybrid there was autocynthetic pairing.

In the parent *Sorghum halepense*, a maximum of 2 quadrovalents were found while in the hybrid, where reduced complement of *Sorghum halepense* was present, occasional formation of tetravalent was also noticed leading to the inference that there may be some homology between one or two of *Sorghum halepense* chromosomes with those of *Saccharum officinarum*.

The back-cross (*vellai* X *Sorghum halepense*) X *Sorghum halepense* seedling G. 1938 has $2n=52$ chromosomes instead of the expected 50 chromosomes. These extra 2 chromosomes are inferred to be *Sorghum halepense* chromosomes from the observations of occasional irregular distribution of chromosome in the F_1 hybrid (i.e., G. 1227).

The seedlings namely Co. 559, Co. 560 and Co. 561 were obtained by selfing the sterile hybrid G. 1938 which had also $2n=52$ chromosomes but having distinct morphological character. These are inferred to have risen by parthenogenesis.

13. Observations on Inter-Racial (*Japonica* X *Indica*) crosses of rice (*Oryza Sativa*, L.). III. Sterility in the F_1 rice hybrids and its effect on the frequency distribution of some quantitative characters in the F_2 generation.

B. MISRO, P. N. SREEDHARAN, V. K. MURALIDHARAN and
S. V. S. PRAKASH RAO, Cuttack.

Sterility is often met with in the F_1 hybrids of inter-specific, inter-racial and even inter-varietal crosses of the cultivated rice. Theoretically (i) the proportion of non-functional gametes in both the micro- and megaspores should be identical and (ii) the fertilization of one by the other should be random. Provided the above two conditions are satisfied, the frequency distribution of the phenotypes in the F_2 generation is expected to be normal. Data collected from six F_2 populations of inter-racial (*Japonica* X *Indica*) crosses on three quantitative characters viz., height, flowering duration and effective tiller number have been presented.

Height is consistently showing significant skewness for all combinations having more than 52% sterility. The behaviour of flowering duration in this respect is less consistent and the effective tiller number is erratic. The nature of distribution of the phenotypes in the F_2 populations is not in any way affected by the fertility status of the soil. The implications of such an effect of sterility on the frequency distribution of the quantitative characters in F_2 for the genetical studies are discussed.

14. Inheritance of certain Morphological characters in rice and their inter-relationships.

B. MISRO, R. H. RICHARIA and M. V. S. SASTRI, Cuttack.

The inheritance of "neck leaf", "polyhusked spikelet", beaked lemma, undulate rachis, verticillate panicle, awning, compact panicle and anthocyanin pigmentation in internode, leaf axil, lemma-palea, apiculus and awn in a cross between two rice varieties (Vis., Murasaki Koyabozu 836×T. 1) has been studied and their inter-relationships ascertained in the F_2 generation. The F_2 data confirm the F_1 observations.

The "neck leaf" and the "polyhusked spikelets" (often met with a teratological abnormalities) have been found to be genetically controlled. Beaked lemma is linked (i) with undulate rachis with a C.O of 46.82% and (ii) with one of the genes for pigmentation in leaf axil with a C.O of 16.6%. The verticillate panicle is linked with one of the genes for pigmentation in the apiculus, with a C.O of 36%. There is evidence of linkage between thirteen other pairs of characters.

Although genes for anthocyanin pigmentation have been reported in the first, second, third and fifth linkage groups of *japonica* rices, according to the present data, the pigmentation genes are also present in the seventh and ninth linkage groups. These data and those furnished in respect of suspected linkage lead one to believe that the linkage groups in the *indica* race may be somewhat different from the ones in the *japonica* race.

15. The Production, availability and requirement of Milk in India and its States in the perspective of Planning.

I. CHATTERJEE and S. SAHA, Calcutta.

India's production of 5293.38 lakh maund of milk (46.71% from cow, 51.23% from buffalo and 2.06% from goat) works out a daily per capita availability of 5.26 oz. or almost half the amount recommended by ICMR. In Kerala, Assam, Orissa and West Bengal the availability varies from less than one-fourth and one-half of 5.26 oz., and in 16 out of 21 pre-reorganised states, and having a population of 315 millions or 89.6%, it lies between 1.27 oz., and 7.07 oz. Only Himachal Pradesh, Punjab, PEPSU, Saurashtra, Rajasthan and Ajmer (with a population of 37 millions) have an availability from 20 oz. to 10 oz.

The authors have worked out the data both in terms of total and fluid fractions of per capita availability on the basis of states with more cow milk than buffalo, with cow and buffalo milk evenly proportioned, and with buffalo milk more than cow milk. The cow zone accounts for 31.16% of milk, even zone 4.8% and buffalo zone 64.04%.

A comparison has been made of this availability with the consumption data obtained by the National Sample Survey during 1950-51. There is a striking agreement between the all-India use of fluid milk and consumption, both being 1.97 oz. per capita per day. From their study a closeness is suggested.

Finally an examination has been made of the needed increase of milk production if the per capita availability could be raised to 7½ oz., 10 oz., and 15 oz. On an all-India basis a 7½ oz. per capita availability requires a 43% increase of present production. Except in the better producing states increased production is needed from 6 to 7% in Madhya Bharat and U.P., and from 483% to 490% in Assam and Kerala.

A 10 oz. availability will require an increase of production by 90% in India, 41% to 43% in Madhya Bharat and U.P., and 677% to 687% in Assam and Kerala. A 15 oz. availability will need an increase of 185% for India, 112% to 114% for

Madhya Bharat and U.P., and 1066% to 1088% for Assam and Kerala. These assessments are stressed as pre-requisites for proper planning. It also presupposes an assessment in terms of different States.

On overall basis only three states (Saurashtra 1000 lb.), Delhi (1270 lb.) and Panjab (1445 lb.) show a yield over 1000 to 1445 lb. The rest vary from 65 lb. to 900 lb. On wet basis 12 states viz. Panjab (2514 lb.), Delhi (2261 lb.), Himachal Pradesh (1944 lb.), Bihar (1755 lb.), Rajasthan (1614 lb.), U.P. (1562 lb.), Saurashtra (1480 lb.), PEPSU (1458 lb.), Madras (1274 lb.), "other areas" (1148 lb.), and West Bengal (1025 lb.) as also Indian Union (1037 lb.) show a yield from 1025 lb. to 2514 lb. whereas three states viz., Himachal Pradesh, Delhi and Panjab show a yield from a little less than 2000 lb. to over 2500 lb. Such differences and incidence of low and high extremes suggest that in India's peculiar condition the yield data in published statistics should be shown on both wet and dry basis.

Panjab, Delhi, Saurashtra and PEPSU belong to top ranking area in more milk yield and lesser proportion of dry animals. A further decrease of dry animal will augment more milk production from cow. Himachal Pradesh and Rajasthan stand next with dry cows slightly in excess. Five states viz., Bihar, U.P., Madras, Travancore-Cochin and West Bengal have milk yield per wet cow varying from 1755 lb. to 1025 lb., but dry cows outnumber the wet cows at 1.83 : 1 to 1.44 : 1. Four states viz., Madhya Bharat, Orissa, Mysore and Jammu and Kashmir have still lower milk yield rates and still higher proportion of dry cows (1.74 : 1 to 2.28 : 1). Then stand Hyderabad, Vindhya Pradesh, Madhya Pradesh, Bombay and Assam with still decreasing milk yield rates. Hyderabad with Madhya Pradesh and Vindhya Pradesh needs an intensive reduction of dry cows, and a progressive reduction of cows in all states is overdue.

It is stressed that a reduction on a basis of 50 : 50 wet and dry cows is not likely to affect the production of the required number of working males, and that a planned reduction is imperative if we seriously want to increase our milk yield-cum-production.

16. The Factors affecting the production, availability and requirement of milk in India and its states in the perspective of planning.

I. CHATTERJEE and S. SAHA, Calcutta.

Between 1951 and 1956 the average rates of milk yield in India have declined from 413 lb. to 361 lb. for cow and from 1101 lb. to 970 lb. for buffalo thereby reducing the per capita availability from 5.26 to 4.76 oz. and possibly still lower. In some states it is even less than one-fourth of India's availability. In terms of planning it implies a correspondingly greater production.

For such low production rates one important reason is the preponderance of dry cows over wet cows. In 15 out of 21 pre-reorganised states wet or milking cows constitute less than one-fourth (24.16) in Hyderabad whereas they are 30.48%, 30.58%, 33.72%, 35.34%, 35.37%, 35.77%, 36.67%, 39.93%, 40.70%, 41.06%, 42.76%, 45.26% and 46.37% respectively in Orissa, Mysore, Madhya Bharat, Madras, Bihar, Travancore-Cochin, Vindhya Pradesh, U.P., "other areas", West Bengal, Madhya Pradesh, Rajasthan and Himachal Pradesh. In India it is 39.87%. Only five states viz., Saurashtra (67.69%), PEPSU (61.7%), Panjab (57.46%), Delhi (56.15%) and Assam (57.44%) have more wet cows, but the production of milk in Assam is very low. Bombay has wet and dry cows evenly divided. The consequence is that except in six states including Bombay, the dry cows exceed the wet cows in the proportion from 3.14 times in Hyderabad, to 2.28 times in Orissa and Mysore, 2 times in Madhya Bharat, 1.83 to 1.73 times in Madras, Bihar, Travancore-Cochin, Jammu and Kashmir, and Vindhya Pradesh, 1.5 to 1.34 times in U.P., "other areas", West Bengal and Madhya Pradesh, and 1.21 to 1.16 times in Rajasthan.

and Himachal Pradesh. Such a large proportion is reflected in a greater food cost for mere maintenance (from 4.14 times to 2.2 times per unit cow) leaving little margin on the productive side for milk. This results in low production and low availability. Such a large preponderance of dry cows reacts in the calculation of yields per cow on overall and wet basis and gives figures hardly indicative of the production potentials of the animal.

17. Methods for control of Udbatta or 'Agarbatti' disease of rice.

N. N. MOHANTY, Bhubaneswar.

Udbatta or 'Agarbatti' disease of rice caused by *Ephelis oryzae* Sydow=*Balansta oryzae* Nar. and Thirumal. occurs in certain early and medium varieties of rice in Koraput, Kalahandi and Phulbani districts of Orissa. It has been observed to cause a loss up to 6% in yield in J₁, a susceptible variety of rice. The disease is manifested with the emergence of an erect greyish-white cylindrical axis much like 'Agarbatti' from the boot leaf sheath, which soon becomes greyish-black in colour. No grain is formed.

Field trials conducted to determine the nature of the disease indicated that the disease is mainly seed borne; since naturally infected rice seeds obtained from Jeypore and raised in sterilised soil at Bhubaneswar, where the disease is not prevalent, produced typical symptoms of the disease in some plants. In another experiment carried on for three years, it was found that, certain plants of some varieties of rice grown at Jeypore from the seeds obtained every year from Central Rice Research Institute, Cuttack, where the disease is not prevalent, could be infected with the disease showing thereby that, the infection could also take place through air or from soil. However, field experiments conducted at Jeypore during 1959 and 1960 indicated that the disease is not soil borne.

Different seed dressing chemicals viz. Agrosan G.N., Ceresan, Tillex and Captain; hot water treatments at 46°C, 54°C and 56°C for 10 minutes and solar heat treatment of the seeds before sowing were tried for four years (1957-1960) for control of the disease. Hot water treatments at 50 to 56°C for 10 minutes and solar heat treatment of the seeds were found to be highly effective in controlling the disease. But, hot water treatment of seeds at 56°C had adverse effect on germination. The effect of different duration of solar heat treatment of seeds was tried and was observed that, solar heat treatment of seeds from 1 hour to 4 hours were effective in controlling the disease. The incidence of the disease was found to be less at Jeypore in case of early sowing (1st week of June) as well as late sowing (2nd week of July) than normal time of sowing (3rd week of June).

18. Weed Control in Wheat—A New Approach.

ANIRUDHA MISRA, Bhubaneswar.

Wheat is grown in Orissa as an irrigated second crop in the Rabi season. In this crop the majority of weeds (80-90%) are annual grasses. So the problem is the control of graminaceous weeds in a crop of the same family. That is why the weedicides specific to control monocot weeds could not be used. There was also no scope to give Pre-emergence spray as unlike Sugarcane, the time taken for germination of cereals is very short. So Pre-sowing spray of the soil was tried to control the annual grasses in the early stage of the crop.

The weedicides 2,4-D and MCPA were taken. Pre-sowing and Post-emergence sprays alone and together in different dose combinations were compared. Local practice of manual weeding was compared alone and in addition to the Pre-sowing

sprays. In all, there were twelve main treatments and two sub-treatments in a layout of split plot design with three replications. Variety N.P. 718 was grown.

The difference among the treatments were statistically significant. The Pre-sowing spray was very effective as it controlled the growth of both Monocot and Dicot weeds in the early stage of the crop and the increase in yield of wheat over control in the Pre-sowing treated plots was nearly 300%. Post-emergence application alone was of very little effect as it killed only the few Dicot weeds. Combinations of 2 lbs. pre-sowing spray with one pound post-emergence spray or manual weeding were the best giving nearly 500% extra yield over the control.

19. Field Tests of Insecticides for Control of Bhindi Jassids *Empoasca devastans* Distant.

G. C. SENGUPTA and J. N. DAS, Bhubaneswar.

The paper reports the results of the insecticides applied against jassid *Empoasca devastans* Distant, a serious pest of lady's finger (*Hibiscus esculentus*). The field trial was conducted on red variety of Bhindi during the year 1960 at the State Agricultural Research Station, Bhubaneswar. Five different treatments and one untreated plot were assigned to 5 replicates in randomized block design. The insecticides tried were (i) parathion 0.025%, (ii) endrin 0.025%, (iii) diazinon 0.025%, (iv) rogor 0.04% and (v) pyrocolloid (1:800). In all, two sprayings of different insecticides were given. The first spraying was given 7 weeks after planting and the 2nd after an interval of 3 weeks. The percentage decline in the nymphal population 48 hours and one week after 1st and 2nd application was noted down and analysed statistically. It was observed that 48 hours after 1st and 2nd spraying, rogor, parathion, endrin and diazinon were almost equal in their toxicity and significantly superior to pyrocolloid. One week after the second application it was observed that the percentage decline in nymphal population in the plots treated with rogor was significantly superior to all other treatments. Endrin was significantly superior to parathion. Diazinon and pyrocolloid were almost equal in their toxicity and were far inferior to the above three treatments.

From the yield figures it was observed that rogor gave the best yield as compared with all other treatments.

20. An Annotated List of Some Parasitic Insects in Orissa.

G. C. SENGUPTA and J. N. DAS, Bhubaneswar.

An annotated list of 19 species of parasitic insects in Orissa is given. Mention may be made of *Encyrtid* sp., *Chellonaurus* sp. and *Gitonides perspicax* Knab. on coffee mealy bug (unidentified); *Neodiscodes* sp. and *Gitonides perspicax* Knab. on casuarina mealy bug (unidentified); *Bracon* sp. (= *Habrobracon*) on *Earlas fabia* Stoll. and *Euzophora perticella* Rag.; *Microplitis* sp. on *Prodenia litura* F.; *Phanerotoma hendecastella* Cam. on *Tirathaba* sp.; *Apanteles baoris* Wilkinson, *Exothecini*? Gen. et sp. (? *Xenosternum*), and *Eupleromalus Darnarae* Gah. on *Parnara mathias* F.; *Phanerotoma* sp. on *Margaronia indica* Saund.; *Cardiochiles* sp., *Temelucha* sp. ? *nigromaculata* Cam. and *Goniozus montanus* Kieff on *Cmaphalocroci medialis* Guen.; *Brachymeria* sp. on *Maruca testulalis* Geyer and *Nola* sp.; *Metachymerus ensifer* Thoms. on *Schoenobius incertulas* Walk.; *Cremastus flavo-orbitalis* Cam. on *Chilostraca infuscatellus* Sn.; *Pachyneuron* sp. on *Trialeurodes ricini* M.; *Closterocerus insignis* Wtrot. on coffee leaf miner (unidentified).

Section XI, Physiology

1. Hippuric Acid Test as an index of Anxiety.

R. B. MATHUR and S. BHAMBAL, Indore.

Study of liver function, has been undertaken in 32 Normal human subjects, in Malwa population, by the hippuric acid excretion test using the method of Quick. The values ranged from 3.67 to 5.01 gms. in the four hour period with an average of 4.62 grams.

An attempt has been made to investigate the effect of the stress of college examination.

The hippuric acid excretion did not show any significant correlation with other indices of anxiety like rise in blood pressure and Taylor's scale rating.

No significant correlation of hippuric acid excretion with surface area, urine volume was observed in normal human subjects.

The role of hippuric acid excretion as an index of anxiety has been evaluated along with other physiological concomitants of examination stress.

2. Effect of protection against summer Stress on respiration, pulse rate, water intake and fodder consumption of buffalo cows.

M. S. MISRA, B. P. SEN GUPTA and A. ROY, Mathura.

The problem of limiting effect of summer stress on animal productivity under tropical conditions can be tackled by focussing our attention on the desirability of modifying the climatic environments, the animals live in, in a way consistent with greater productivity. The present study was, therefore, designed to obtain, as preliminary step, quantitative informations on the influence of the important climatic elements on the various physiological responses under the two contrasting climatic environments under study.

Ambient Temperature ranged from 87.20-91.30°F. in the protected and from 86.0-108.10°F. in the unprotected group. Humidity showed a range of 52.10-61.50% in the former and of 29.70-46.0% in the latter. Both respiration and pulse in the unprotected group were significantly higher than those in the protected group during the period of actual stress. Respiration was found to have a high correlation with ambient temperature ($r=0.81$) whereas the pulse rate/temperature correlation was insignificant ($r=0.224$). The multiple correlation of temperature, humidity and respiration was high ($R=0.87$) indicating that the variations in respiration under the conditions of the experiment are mostly explained by temperature and humidity.

The multiple regression equation suggests that temperature is roughly four times more effective in causing variation in respirations than humidity.

Fodder consumption in the two groups were spectacularly distinct, the "protected" value being almost double of the "unprotected" one. Water intake, however, showed a reverse trend—the "unprotected group" intake being significantly more than that of the "protected group". Of all the physiological responses studied in relation to climatic stress, respiration appears to be of highest accuracy as a measure of heat tolerance.

3. Beneficial effects of protection against summer stress on milk production in buffalo cows.

M. S. MISRA, B. P. SEN GUPTA and A. ROY, Mathura.

The present study was designed to establish, as a preliminary step, the extent of improvement in milk production that can be brought about by reorienting the concept of summer sheltering for milch animals, on a climatological as opposed to empirical basis, providing thereby the animals necessary protection against the main hazardous components of summer climate viz. temperature and radiation.

The climatic picture of the protected and unprotected groups were as follows :

Ambient temperature—Morning 86.7°F (87.5°F), Afternoon 90.8°F (101.1°F),

Relative Humidity—Morning 61.5% (46.0%), Afternoon 52.1% (29.7%),

Maximum Temperature—91.3°F (108.1°F),

Minimum Temperature—87.2°F (86.0°F),

Radiation Exchange from surroundings—Nil (58.0 ± 3.4 KCal/Sq. m/hr) (In Animal Shed)

Figures in parenthesis are for the unprotected group. Both the morning and afternoon milk yields were higher in the protected group than their corresponding values in the unprotected lot, and the differences were highly significant. Within each treatment group again, the morning yield revealed a significantly higher value than the evening one, showing thus an inverse correlation with diurnal fluctuations of ambient temperature. Analysis of variance reveals that the greatest source of variation under the conditions of the experiment was between "treatments" (viz., protection vs. non-protection). The variation in the yield between week groups was also highly significant. There was also a significant variation in the milk yield from week to week within each "treatment" group.

The multiple correlation coefficient of milk yield, temperature and humidity ($R=0.58$) does not show a very high value which is suggestive that besides the temperature and humidity some other unexplained but important factors (climatic, physiological, nutritional etc.) are also responsible for a sizeable variation in the complex physiological processes of milk production.

The multiple regression of milk yield on temperature and humidity reveals that the ambient temperature was thrice more effective in influencing the productivity in the animals than the humidity.

The net outcome of the provision of protection against summer stress was 30% increase in milk yield which warrants its exploitation on a larger scale especially in the organised dairy farms.

4. Physical and Metabolic Behaviour of Jamnapari Goat and Bikaneri Ram Spermatozoa during Autumn.

M. S. MISRA, B. P. SEN GUPTA and A. ROY, Mathura.

The present study aimed to evaluate the quality of goat and ram semen during autumn so as to judge their respective suitability for use in artificial breeding programmes in these species consequent to "telescoping" the oestrous in the females during the same period.

The semen characteristics studied included ejaculate volume, initial motility, sperm concentration, percentage live, cold shock resistance as revealed by the

percentage survival of spermatozoa following the treatment and oxygen uptake. The respective values are :—

0.92 ± 0.05 ml (0.65 ± 0.072), 4.0 ± 0.42 (2.28 ± 0.50),
 $5.313 \pm 0.786 \times 10^9$ ($4.08 \pm 0.46 \times 10^9$),
 $87.03 \pm 1.8\%$ ($54.55 \pm 4.92\%$), $1.82 \pm 0.43\%$ ($6.74 \pm 1.56\%$),
 $172.7 \mu\text{l}/10^9$ spermatozoa/hr. ($52.34 \mu\text{l}/10^9$ spermatozoa/hr.).

The values in the parenthesis are those of buck semen.

In general the goat spermatozoa appeared to be more adversely affected by the autumn climate as revealed by significantly lower values of these seminal attributes as compared to those of ram. The sperm concentration in the two species was, however, not significantly different.

The cold shock resistance did not reveal any predictable pattern in either species and was rather somewhat erratic. The ram spermatozoa showed practically no resistance to cold shock which otherwise appeared to be of a good quality judged by physical and metabolic attributes under study. Paradoxically the cold shock resistance of buffalo spermatozoa which had been shown to be intrinsically of a poorer quality than that of ram was many times superior under identical climatic environments.

In view of the poor quality semen obtained from goats during autumn, it is suggested to consider the advisability of shifting the breeding operation in this species to some other period of the year characterised by the availability of a reasonably better quality semen. In case of sheep, if the physical and metabolic indices under study are any indication, the choice of autumn for artificial mass breeding appears to be a rational approach.

5. Growth of Fistulated Animals and Standardisation of Methods.

H. C. PANT, J. S. RAWAT and A. ROY, Mathura.

A preliminary study was undertaken on certain aspects of rumen physiology. Seventeen animals were used for the different investigations; out of these a few had permanent rumen fistulae fitted with air-tight plugs. Throughout the course of these investigations the composition and the amount of the concentrate mixture fed to the animals was kept constant. All the investigations were done with three species of ruminants viz. buffalo, sheep and goat.

The plug used to close the rumen fistula was found to maintain perfect anaerobiosis inside the rumen since the growth rate fistulated buffalo calves was found normal. No significant difference was obtained in the concentration of total volatile fatty acid (TVFA) and ammonia (NH_3) as well as in the cellulolytic activity of rumen liquor obtained from fistulated and slaughtered animals maintained on the same plane of nutrition. It was concluded from this finding that the sampling technique for the collection of rumen liquor from fistulated animals gave samples which could be considered representative of the whole rumen ingesta. Starvation for 24 hours was found to decrease the cellulolytic activity of rumen inoculum as well as the concentration of TVFA and NH_3 . By paper chromatography acetic, butyric, and propionic acids were separated from the rumen liquor. Digestion of cellulose *in vitro* gave rise to more propionic than acetic acid, whereas green berseem (*Trifolium alexandrinum*) produced the two acids almost in equal ratio.

Marked seasonal variation was observed in the cellulolytic activity of the rumen inoculum obtained from fistulated animals maintained on the same plane of nutri-

tion. By *in vitro* technique the cellulolytic activity of rumen inoculum obtained from sheep and goat kept under identical management were found to vary significantly, the activity in the former being lesser than that in the latter species.

6. Some observations on Respiration and blood pressure on stimulation of the cut central end of vagus and sciatic nerves.

V. S. C. RAO and M. S. CHAUDHRY, Jabalpur.

In a series of 10 dogs a study was undertaken to compare the response on stimulation of cut central end of vagus in the neck and abdomen with the response on stimulation of the cut central end of the sciatic nerve.

The response obtained on stimulation of the cut central end of vagus in the neck, or in the abdomen or the sciatic nerve showed sometimes the rise in blood pressure, sometimes a fall in blood pressure and sometimes a biphasic response. The response varied with the strength, duration and frequency of the current used for stimulation.

In the pressure response from the cut central end of cervical vagus the Traube Herings waves always disappeared. In the response obtained from the cut central end of abdominal vagus and sciatic nerve the Traube Herings waves never disappeared.

The response on the stimulation of cut central end of cervical vagus showed apnoea in large majority of observations, in some cases apnoea was followed by stimulation of respiration and in some there was slowing of respiration and in a few cases there was stimulation of respiration. The apnoea occurred at the end of normal expiration. On stimulating the cut central end of abdominal vagus and the sciatic nerve, stimulation of the rate of respiration was the only response obtained in all observations.

The conclusion drawn from these experiments suggests that the response obtained on stimulation of the cut central end of abdominal vagus and the sciatic nerve on blood pressure and respiration has probably a similar mechanism and supports the hypothesis that the pressure response obtained by stimulation on the cut central end of vagus is due to stimulation of the general afferent fibers present in the abdominal vagus.

Section XII. Psychology and Educational Sciences

1. Spontaneous Recovery in Probability Learning.

J. P. DAS and A. K. MITRA, Cuttack.

In the present study an attempt has been made to demonstrate, if possible, the Spontaneous Recovery of a probability response. The probability learning task was a simple one. Two nonsense syllables—Jagapa and Kachada—were paired with adjectives 'good' and 'bad'. The probability of 'good' appearing after Jagapa and 'bad' after Kachada was 80 during acquisition series. But during extinction series 'good' and 'bad' followed the two nonsense syllables with equal probability, i.e., 50/50. The trials for both acquisition and extinction remained constant. They were 280 trials, half of which were Jagapa and the other half Kachada, arranged in a predetermined random schedule. The Ss would be asked to guess whether 'good' or 'bad' would follow immediately E called out the nonsense syllable. Ss were required to record their guesses in paper, after which E announced 'good' or 'bad' according to the probability.

Four groups of Ss each consisting of 20 male students, were taken. Of the four groups, two belonged to Experimental condition and the rest two to Control condition. Both the Experimental groups received the acquisition and extinction trials in one continuous session. Then a rest pause of 5 minutes was given to one group and 30 minutes to the other. Following rest, two tests for evidence of Spontaneous recovery were tried. This was done by requiring Ss to choose 10 adjectives for each non-sense syllable from a randomly presented list of 10 favourable and 10 unfavourable adjectives. In addition Ss were asked to rate the two nonsense syllables on three seven point scales (Good-Bad; Strong-Weak; Active-Passive). If Spontaneous recovery occurred, then choice of adjectives and ratings would be favourable for Jagapa which was followed by 'good' 80% of the time in acquisition and unfavourable for Kachada. Of course these responses were compared with the responses of the control groups. Of the two control groups one group received only acquisition trials and the other only extinction trials. Then choice of adjectives, ratings for the two non-sense syllables were done. From the result it was found out that the two control and two experimental groups do not differ significantly from each other. No difference was also found between the two control and the two experimental groups. So it is not possible to conclude as to whether Spontaneous recovery has taken place or not. In that case at least the two control groups would have differed in their scores. The .50 group (Second control group) should have been given positions mid between Good-Bad, but it was found that the first nonsense syllable Jagapa was judged to be good and the second syllable Kachada as bad. Then it was argued that probably when Ss were asked to judge two stimuli on a good-bad continuum, they cannot give stimuli neutral places. They tend to see one as good and the other as bad. This hunch was subsequently proved by taking another two groups of Ss who were asked to choose adjectives for the nonsense syllables and rate them. These Ss had not received the probability learning trials before choosing adjectives and rating the scales. However while instructing the Ss the first nonsense syllable Jagapa was mentioned first to one group and the same was mentioned in the second place to the other group. It was found that favourable responses were given for the syllable that occurred first and unfavourable for the syllable that occurred in the second place.

A subsequent experiment was then designed with another two groups, each consisting of 20 Ss. The stimulus probability during acquisition was the same as in the previous experiment for acquisition. But for the extinction period the stimulus probability was reversed whereas in the first experiment it was .50/.50. One of the two groups served as a control group for the reversed probability. The rest period before testing for Spontaneous recovery was 30 minutes. As expected it was found that the experimental group selected and rated the stimuli consistent with the stimulus probabilities of acquisition rather than those of extinction. Thus the phenomenon of Spontaneous Recovery was observed in the probability learning situation.

Section XIII. Engineering and Metallurgy

1. "Painting systems for Timbers".

M. M. SHIRSALKAR, S. M. SINGH, G. W. KAPSE and N. K. PATWARDHAN
Central Building Research Institute, Roorkee.

The scarcity of traditional timber viz., teak has led to the widespread use of secondary species (soft timbers) for making doors and windows etc. Unlike teak the nature of these timbers put a much more severe strains on the paint

system. More often than not unseasoned timbers are used which further aggravates the situation. Under these circumstances suitable protective paint systems have to be found out for different species.

Outdoor exposure tests reveal that systems based on alumination primer perform well on soft timbers. In systems using alkyd finishing paint the undercoat did not influence the performance of the top finishing coat. Exterior finishing oil paints without undercoating performed better than with under coat. The life of the latter system is hardly 7/8 months, whilst the alkyd paints perform much better than oil paints and emulsion paints. The latter were found to put up a better performance on white lead primer than on aluminium primer. These paints suffered from mould growth. Emulsion paints did not offer protection for more than 9 months.

Further exposure studies on these paints on seasoned panels are in progress.

2. Characteristics of Induction Motor with D.C. Rotating Field.

P. KUNDU, Banaras.

Conventional induction motor is constructed with 'rotating magnetic field' produced by poly-phase alternating current in distributed poly-phase winding. Outer stator body or armature of a salient-pole alternator is put on two more bearings so that outer body can take continuous rotation. If now the D.C. salient-pole is excited and rotated by another prime-mover and armature short-circuited the outer body will move as an induction motor.

Characteristics of this induction motor is found to be similar to conventional motor if power-factor of armature circuit is high. If power factor is low demagnetising effect of armature will reduce D.C. field current and lesser amount of torque will be transmitted across air-gap by the D.C. rotating field.

Even with squirrel cage armature winding and with properly designed D.C. field winding continuous variation of speed of armature is possible over a considerable speed range by varying D.C. excitation. Construction of an 'one unit system' incorporating electric prime-mover and main variable-speed motor is suggested at the end.

From the similarity of Transformer-Induction Motor-Alternator secondary or armature side armature-reaction is viewed as equivalent to primary side load ampere turn.

Secondary leakage reactance is experimentally determined and found to be several times that measured by 'Potier Method'.

3. Influence of Acriflavine and of some Inorganic Inhibitors on the Dissolution of Steel in Sulphuric Acid.

C. K. MITAL, HIRA LAL and I. P. ANOSHCHENKO, Bombay.

1. The effect of acriflavine, stannous chloride, stannic chloride, and sodium bromide and their combinations on the dissolution of mild steel in $2\text{NH}_4\text{SO}_4$ has been investigated.
2. It has been shown that in air, at room temp., stannous chloride is a good inhibitor. The protective action of this inhibitor increases from 70.4% at a concn. of 1 mgM/L to 93.5% at a concn. of 10.0 mgM/L $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$.
3. Under the same conditions, acriflavine is a good inhibitor. Even at a concn. of 0.25 mgM/L the protective action is 48.0%, and with an increase in concentration upto 3.0 mgM/L, protective action of the inhibitor is increased to 80%.

4. Sodium bromide is a poor inhibitor for the corrosion of steel in H_2SO_4 . Its protective action at 3 mgM/L is 39 and on increasing the concentration upto 20.0 mgM/L, the protective action does not exceed 69%.
However, a combination of NaBr and acriflavine (5.0 mgM/L NaBr+1.0 mgM/L acriflavine) and NaBr and $SnCl_2 \cdot 2H_2O$ (5.0 mgM/L+5.0 mgM/L, respectively) gives a protective action exceeding 97%.
5. Some remarks have been made regarding the mechanism of inhibitor action.

DISCUSSION

I. ABSOLUTE SUMMABILITY OF FOURIER SERIES

Section of Mathematics

Chairman : DR. P. L. BHATNAGAR, Bangalore.

1. T. PATI : *Absolute Riesz and Nörlund Summability of a Fourier Series.*

In the wake of the researches of Wang on the Riesz summability of a Fourier series at a point, Mohanty (PLMS, 1951) obtained certain preliminary results on the absolute Riesz summability of a Fourier series, its conjugate series and their derived series. These results of Mohanty were superseded and generalised in the works of Pati (Trans. Amer. Math. Soc., 1954; Proc. NISI, 1957), Matsumoto (Tôhoku Math. Jour., 1957) and Sinha (Proc. NISI, 1958). The ultimate result in this direction bridges the gap between Bosanquet's classical results on $|C|$

summability and Pati's theorems on $|R, \exp \{(\log w)^{1+1/a}\}, a+\delta|$ for $\delta > 0$. Matsumoto's theorem for Fourier series, which is the most general, is established essentially through a conjunction of the techniques developed by Pati and certain standard formulae readily available in Bosanquet's work, while Sinha's results, which are coextensive with Matsumoto's in the case of integral a and cover the conjugate and derived series also, are obtained entirely by means of techniques developed by Pati.

A curious Tauberian technique was hit upon by Mohanty for proving an analogue of Hardy-Littlewood's convergence criterion for Fourier series, and instead of working with Valiron means, which Hardy and Littlewood had used, Mohanty had used the basic result (PLMS, 1949) : If $\Phi(t) \log(k/t) \in BV(0, \pi)$, then the Fourier series of $\Phi(t)$ at $t=0$ is summable $|R, \exp(-\omega^\delta), 1|$ where $0 < \delta < \infty$. This is an analogue of a theorem of Wang.

On absolute Riesz logarithmic summability we have results from Izumi and Kawata (Tôhoku Math. Jour., Vol. 45) and Mohanty and Mohapatra (Math. Zeitsch., 1956).

Although on the absolute Nörlund summability of Fourier series of Lipschitz class, several results had been obtained by Mc Fadden as early as 1942 (Duke Math. Jour.) as generalisations of previous results of Hyslop and others, it is remarkable that nothing had been done with regard to the absolute Nörlund summability of the Lebesgue-Fourier series until in 1959 Pati's paper on this subject was published in the Journal of the London Math. Soc. Subsequent work by Pati in this direction has been partly announced in the volume of Abstracts of the Proc. of the current session of the Indian Science Congress. These results generalize results of Bosanquet and Hyslop.

Pati has meanwhile also tackled the problem for differentiated Fourier series and also generalised certain other previous results of Bosanquet on $|C|$ summability by using Nörlund means.

The most remarkable result, however, seems to be the following theorem by Pati (forthcoming in the Jour. Indian Math. Soc.) : If $\Phi(t) \log(k/t) \in BV(0, \pi)$,

or even $\in AC(0, \pi)$, it is not necessary that the Fourier series of $\Phi(t)$ at $t=0$ is summable $[N, 1/(n+1)]$. This establishes that Iyengar's well-known theorem on Harmonic summability has no direct analogue for absolute summability.

2. PRAMILA SRIVASTAVA (Allahabad) : *Absolute Abel Summability and Absolute Cesàro Summability of a Fourier Series.*

It was in 1911 that Fekete introduced the notion of absolute Cesario summability and absolute Abel summability was introduced by Whittaker in 1930. The relationship between the two methods of summability may be expressed by $|C, \alpha| \subseteq |A|$, for every $\alpha \geq 0$. The first result on absolute summability of a Fourier series due to Whittaker (P.F.M.S., 1930) states that under Dini's criterion for convergence a Fourier series is summable $|A|$. The question as to whether at least for a Fourier series $|A| \subseteq |C, \alpha|$, or vice versa, was answered in the negative by Whittaker (loc. cit.) and Prasad (P.F.M.S., 1930). Theorems on summability $|A|$ and summability $|C|$ have been obtained among others by Prasad (P.L.M.S., 1933), Misra (P.M.S.I., 1933) and Bosanquet (P.F.M.S., 1934; J.L.M.S., 1936; P.L.M.S., 1936). The most comprehensive results in this direction due to Bosanquet are to the effect that if $\Phi_\alpha(t) \in BV(0, \pi)$, then the Fourier series is summable $|C, \beta|$, $\beta > \alpha \geq 0$, and if the Fourier series is summable $|C, \alpha|$, $\alpha \geq 0$, then $\phi_\beta(t) \in BV(0, \pi)$, $\beta > \alpha + 1$. Hence it follows that summability $|C, \delta| > 1$, is a local property. That this is not true for $0 < \delta \leq 1$ was demonstrated by Bosanquet and Kestelman (P.L.M.S., 1939) and also by Randel's (B.A.M.S., 1940). Randel's (B.A.M.S., 1938) gave an example to show that for a Fourier series also $|A| \not\subseteq |C|$. Summability $|C|$ of a Fourier series of a function belonging to the class L^p has been investigated by Alberto Foa (B.M.I., 1940 and 1941), Yano (T.M.J., 1953), Sanouchi (J.M.S., Japan, 1949) and Tsuchikura (M.J., 1949; T.M.S., 1953). For summability $|C|$ of Fourier series of functions of the *Lipchitz class* investigations have been made by Hyslop (P.L.M.S., 1937) and Chow (P.L.M.S., 1937 and J.L.M.S., 1942). Yet another class of criteria for summability $|C|$ of a Fourier series, which may be said to be of the *Dini Lipchitz* type, have been developed. Matsuyama (T.M.J., 1950) and Chow (J.L.M.S., 1955). Still further results in this direction have been recently obtained by K. Yano (T.M.J., 1960) and by Hsiang (P.A.M.S., 1960).

3. S. N. BHATT (Allahabad) : *An aspect of local property of absolute summability of a Fourier Series* (Presented at the symposium by Z. U. Ahmad).

1.1. Let $f(t)$ be a periodic function with period 2π and integrable L_1 over $(-\pi, \pi)$, and let its Fourier series be

$$\sum A_n(t) = \frac{1}{2} a_0 + \sum_{n=1}^{\infty} (a_n \cos nt + b_n \sin nt).$$

1.2. Bosanquet, in 1936, proved that the summability $|C, \alpha|$, $\alpha > 1$, of a Fourier series is not a local property. Bosanquet and Kestelman have proved, however, that the summability $|C, 1|$ of a Fourier series at a point is not a local property.

I have proved that a necessary and sufficient condition that $|C, 1|$ summability of a Fourier Series be a local property is that $\sum |A_n k|/n$ is convergent. The problem for the case $|C, \beta|$ summability where $0 < \beta < 1$ was tackled by Jurkat and Peyerimhoff. I have recently established that if p_n is non-negative, monotonic non-increasing, $p_n \rightarrow \infty$, $p_n = O(n^\delta)$ ($0 < \delta < 1$) and $\sum |A_n(x)/p_n| < \infty$, then $|N, p_n|$

summability of $\Sigma A_n(t)$ is a local property. This theorem which is of extremely general character includes as a particular case the above mentioned theorem of Jurkatz and Peyerimhoff.

1.3. Mohanty and Izumi have independently generalised the theorem of Bosanquet and Kestelman by proving that the summability $|R, \log n, 1|$ of a Fourier series is a non-local property. Matsumoto further generalised this theorem by proving that the summability $|R, \log n, 1|$ of even the series $\Sigma A_n(t)/\log \log (n+1)$ cannot be ensured by a local hypothesis. This result has recently been extended by Dikshit for general Riesz summability $|R, \lambda_n, 1|$.

Mohanty and Izumi have proved that if $\Sigma \{|A_n(x)| \log \log n\}/n$ be convergent then the $|R, \log n, 1|$ summability of a Fourier series at a point is a local property. I (Tôhoku, Vol. II (1959)) have generalised this theorem by proving that a necessary and sufficient condition that the summability $|R, \log n, 1|$ of a Fourier Series be a local property is that $\Sigma \frac{A_n(t)}{n \log n}$ is convergent. The general case of $|R, \lambda, 1|$ summability has recently been discussed by Dikshit and corresponding result which is parallel to that of mine has been given.

2.1. Matsumoto proved that $|C, 1|$ summability of a factored fourier series $\Sigma A_n(t)/\log n)^{1+\epsilon}$, $\epsilon > 0$, can be ensured by a local condition. This result of Matsumoto is included in the following theorem established by Prasad and myself (Duke J.M., Vol. 24 (1957)).

If $\{\lambda_n\}$ is a convex sequence such that $\Sigma n^{-1} \lambda_n$ is convergent and $t_n^{-1} = o(\log n)^k (C, 1)$, $k > 0$ then the series $\Sigma \{\log(n+1)\}^{-k} \lambda_n a_n$ is summable $|C, 1|$ where t_n^{-1} denotes n^k Cesàro mean of order one of sequence $\{a_n\}$. The particular case of this result for $k=0$ is due to Pati. Since when a series is convergent $t_n^{-1} = o(1)$ as $n \rightarrow \infty$ and since convergence is a local property, it follows that if λ_n is a convex sequence such that $\Sigma n^{-1} \lambda_n$ is convergent then the summability $|C, 1|$ of the factored Fourier series $\Sigma A_n(t) \lambda_n$ at a point is a local property.

2.2. Mohanty has demonstrated that the summability $|R, \log n, 1|$ of $\Sigma A_n(t)/\log(n+1)$ at $t=x$, is a local property of the generating function of $\Sigma A_n(t)$. I (P.N.I.S. Vol. 26. A 1960) have generalised this result by proving that if $\{\lambda_n\}$ is a convex sequence such that the series $\Sigma n^{-1} \lambda_n$ is convergent then the $|R, \log n, 1|$ summability of the series $\Sigma A_n(t) \log n \lambda_n$ at a point can be ensured by a local property. The result obtained includes as a particular case a previous result of Matsumoto.

Very recently, S. N. Lal has proved that the absolute harmonic summability of the factored Fourier series $\Sigma n^{-1} \{\log \log(n+1)\}^{-1-\epsilon} A_n(t)$, $\epsilon > 0$, can be ensured by a local condition. He has also established some important results on the localisation of absolute summability of the derived series of a Fourier series.

4. S. R. SINHA (Allahabad) : Absolute Abel and Cesàro Summability Factors.

1. A given series Σa_n is said to be absolutely summable (A), or summable $|A|$, if $F(x) = \Sigma a_n x^n$ is convergent for $|x| < 1$, and $F(x)$ is a function of bounded variation in $(0, 1)$.

The series Σa_n is said to be absolutely summable (C, ρ) , or summable $|C, \rho|$, if the sequence $\{s_n\}$ of n -th Cesàro means of order ρ ($\rho > -1$) of partial sums s_n of Σa_n , is of bounded variation, that is,

$$\Sigma |s_n^\rho - s_{n-1}^\rho| < \infty.$$

Summability $|C, \rho|$, $\rho > -1$, implies $|A|$, but not conversely.

2. Let $f(t)$ be integrable (L) over $(-\pi, \pi)$, and periodic 2, and let its Fourier series be given by

$$\sum_{n=1}^{\infty} (a_n \cos nt + b_n \sin nt) \equiv \sum_{n=1}^{\infty} A_n(t),$$

and

$$\phi(t) = (1/2) \{ f(x+t) + f(x-t) - 2f(x) \}.$$

3. Prasad (P.L.M.S., 1933) was the first to investigate into the problem of factors in the theory of Absolute Summability. He established the following theorem on $|A|$ -summability factors.

$$\text{If } \int_0^t |\phi(u)| du = o(t), \text{ as } t \rightarrow 0, \dots \dots \dots (1)$$

then $\sum \lambda_n A_n(x)$ is summable $|A|$, where $\{\lambda_n\}$ is any one of the sequences

$$\{(\log n)^{-1-\epsilon}\}, \{(\log n)^{-1} (\log \log n)^{-1-\epsilon}\}, \dots \dots \dots (2)$$

$$\{(\log n)^{-1} (\log \log n)^{-1} \dots (\log \log \dots \log_p n)^{-1-\epsilon}\}, (\epsilon > 0).$$

In 1938, Izume and Kawata extended this result to the case of factors λ_n , where $\{\lambda_n\}$ is a convex sequence such that $\sum (\lambda_n/n) < \infty$. Cheng in 1948 extended Prasad's theorem by replacing summability $|A|$ by summability $|C, 1+\delta|$, $\delta > 0$. In 1954 Pati generalised all these results by replacing sequence (2) in Cheng's theorem by a convex sequence $\{\lambda_n\}$, when $\sum (\lambda_n/n) < \infty$.

This result has been further extended by Dikshit (Bull. Cal. Math. Soc., 1958) by replacing (1) by

$$\int_0^t |\Phi_h(u)| du = O[t \{ \log(1/t) \}^\beta], \beta > 0, \dots \dots \dots (3)$$

as $t \rightarrow 0$, and $\Phi_h(t)$ is the Riemann-Liouville integral mean of Φ of order h , where $h=0$, and the sequences (2) by $\{\lambda_n (\log n)^{-\beta}\}$, $\{\lambda_n\}$ being a convex sequence, and such that $\sum (\lambda_n/n) < \infty$.

Recently Pati and Sinha (Indian Journ. Math., 1958-59) have generalized Pati's result in another direction by the introduction of a new concept of 'hyperconvexity'. A sequence is said to be 'hyperconvex of order h ' ($h=0, 1, 2, \dots$) if $\Delta^{h+1} \lambda_n \geq 0$. By definition 'hyperconvexity of order zero' is the same as 'convexity'. They proved that—if (3) holds with $\beta=0$, and if h be an integer ≥ 0 and $\{\lambda_n\}$ be a monotonic non-increasing sequence when $h=0$, and a hyper-convex sequence of order $(h-1)$ when $h \geq 1$, such that

$$\sum n^{-1} \lambda_n < \infty \text{ and } \sum n^h \Delta^{h+1} \lambda_n < \infty,$$

then the series $\sum \lambda_n A_n(x)$ is summable $|C, h+1+\delta|$ for every $\delta > 0$.

The result has been further generalized and extended by Ahmad in the following form and includes all the previous results known in this line.

Let h be an integer ≥ 0 , and let $\{\lambda_n\}$ be a sequence such that $\Delta^{h+1} \lambda_n > 0$, and $\sum (\lambda_n/n) < \infty$. Then, if (3) holds, the series $\sum A_n(x) \{\lambda_n (\log n+1)^{-\beta}\}$ is summable $|C, h+1+\delta|$, for every $\delta > 0$.

Chow established (J.L.M.S., 1941) that for a convex sequence $\{\lambda_n\}$ such that $\sum (\lambda_n/n) < \infty$, the series $\sum \lambda_n A_n(t)$ is summable $|C, 1|$ for almost all values of t . He based the proof of his theorem on a result of Marcinkiewicz concerning the strong summability of Fourier series. The set of points at which his result holds, is not necessarily the Lebesgue set in which Prasad's theorem holds. The

question naturally arises as to whether the summability $|C, 1|$ of $\sum \lambda_n A_n(x)$ can be ensured by the condition (1), taking the $\{\lambda_n\}$ to be a convex sequence such that $\sum n^{-1} \lambda_n < \infty$, and $f(t)$ be just integrable (L). This remains an open question even in the special case $\lambda_n = (\log n)^{-1-s}$, $s > 0$. The analogous question for power series on its circle of convergence has, however, been considered by Pati (Abstracts, IMS Conf., 1959) who has proved the following result with the help of a general theorem of his on the absolute Cesàro summability factors of infinite series and a previous theorem by Hardy and Littlewood on the strong summability of power series on its circle of convergence.

If $f(z) = \sum c_n z^n$ is a power series of complex class L, such that

$$\int_0^t |f(e^{i\theta})| d\theta = O(t) \quad (|t|), \text{ as } t \rightarrow 0, \dots \dots \dots (4)$$

the $\sum \lambda_n c_n$ is summable $|C, 1|$.

Cheng (Duke Math. Jour., 1948) proved that if $0 < \alpha < 1$, and $\Phi_\alpha(t)$ is of bounded variation in $(0, \pi)$, then $\sum \lambda_n A_n(x)$ is summable $|C, \alpha|$, where $\lambda_n = (\log n)^{-1-s}$, $s > 0$. Subsequently Sunouchi in 1954 extended this result to all positive values of α , and Ahmad has extended Sonouchi's theorem still further. In 1957 Prasad and Bhatt (Duke Math. Jour.) also generalized Chen's theorem in another direction and proved some new results on the $|C|$ -summability factors of Fourier series. Recently some of the theorems of Prasad and Bhatt have been extended by Dikshit (PNIS, 1959).

Several other extensions and generalizations of the theorems of Cheng (Duke Math. Jour., 1947-8) have been effected by Cheng himself, Prasad and Bhatt, Dikshit and Srivastava (PNISI, 1958), of which Srivastava's result is the most general one.

5. G. D. DIKSHIT (Allahabad) : *Absolute Riesz Summability Factors for a Fourier Series.* (Presented at the Symposium by Mr. B. D. Malaviya).

In the study of absolute Riesz Summability of Fourier Series the theory of summability factors was for the first time employed in 1951 by Mohanty. In an earlier paper [P.L.M.S. (2), 51 (1950)] he had proved that if $\Phi(t) \left(\log \frac{k}{t}\right)^s \in Bv(0, \pi)$, $k > \pi$, then the Fourier series $\sum A_n(t)$ of $f(t)$, at $t=x$, is summable $|R, \exp(n^\alpha), 1|$, where $\Phi(t) = \frac{1}{2} [f(x+t) + g(x-t) - 2f(x)]$, and $0 < \alpha < 1$. He took up the problem of determining the sequence of summability factors in order that the factored Fourier series may be summable $|R, \exp(n^\alpha), 1|$, when only it is known that $\Phi(t) \in Bv(0, \pi)$, and showed that the sequence $\left\{ \frac{1}{\log(n+1)} \right\}$ serves to be one [P.L.M.S. (2), 52 (1951)]. In 1954, Mohanty and Misra took up the problem of absolute Riesz summability of the type $\{\exp(\log n)^\beta\}$, $\beta > 0$, and proved that if $\Phi_\alpha(t)$ —the α -th integral mean of $\Phi(t)$ —is a function of bounded variation in $(0, \pi)$, for $0 < \alpha < 1$, then the factored series $\sum A_n(t) \{\log(n+1)\}^{-1}$, at $t=x$, is summable $|R, \exp(\log n)^{1+\delta}, 1|$ [T.M.J. (2), 6 (1954)]. Recently considering the general cases for $\alpha > 0$, Dikshit has proved that if $\alpha > 0$, $\beta > 0$, $\Phi_\alpha(t) \left(\log \frac{k}{t}\right)^{s+\beta} \in Bv(0, \pi)$, $k > (\pi+1)$, then the factored series $\sum A_n(t) \{\log(n+1)\}^{-1}$ at $t=x$ is summable $|R, \exp(\log n)^{\delta+\alpha\beta}, 1|$, where $\delta > 1+\alpha\beta$, and also in the case $\beta > 1$, $0 < \alpha < \frac{\beta-1}{\beta}$, $\delta > \beta$ [Indian J.M., 3 (1961)]. Very recently the special case, $\alpha=1$, of this theorem has received a further generalization at the hands of S. N. Lal who

has proved that if $\Phi_1(t) \in B_v(0, \pi)$, then the series $\sum A_n(t) \{\log(n+1)\}^{-1-\epsilon}$, at $t=x$, is summable $[R, \exp(\log n)^\beta, 1]$ for $\beta, \epsilon > 0$ (Abstract of the paper to appear in 'ABSTRACT OF PAPERS' presented for the twenty-seventh Conference of the Indian Mathematical Society, Ahmedabad, 1961).

Matsumoto applied the theory of summability factors to study the absolute Riesz summability of a Fourier series in another direction. He first proved that absolute Riesz summability of certain logarithmico-exponential types and order unity of a Fourier series is not a local property. Then he investigated into the nature of the sequence of summability factors which can make the factored Fourier series summable at a point under consideration and gave a set of results. Actually he has given summability-factor-sequences $\{l_n\}$ so that the series $\sum A_n(t) l_n$ may be summable $[R, \lambda_n, 1]$, where the type sequence $\{\lambda_n\}$ is of either forms: $\exp(n^\alpha)$, $0 < \alpha < 1$; $\exp(\log n)^\beta$, $\beta > 0$, and $\exp(\log n)^\beta$, $\beta > 0$, and the function $\Phi(t)$ satisfies certain Lebesgue-set type of conditions [T.M.J. (2), 8 (1956)]. Results of Matsumoto have been generalized as far as summability factors are concerned by Pramila Srivastava (ABSTRACTS, P. I.S.C.A., 45th Session, Madras 1958).

6. S. M. MAZHAR (Allahabad) : Absolute summability with indices.

1.1. Let $f(t)$ be a periodic function with period 2π and integrable (L_1) in $((-\pi, \pi))$ and let its Fourier series be given by

$$f(t) \sim \sum_{n=0}^{\infty} A_n(t).$$

and suppose that the series conjugate to Fourier series is

$$\sum_{n=0}^{\infty} B_n(t).$$

We write

$$\varphi(t) = f(x) + t + f(x-t), \quad \Psi(t) = f(x) + t - f(x-t),$$

$$\Phi_\alpha(t) = \frac{1}{\Gamma(\alpha)} \int_0^t (t-u)^{\alpha-1} \varphi(u) du \quad \alpha > 0,$$

and

$$\Phi_0(t) = \varphi(t)$$

Let t_n^β denote the n -th Cesàro mean of order β of the sequence $\{nA_n(x)\}$, \bar{t}_n^β that of $\{nB_n(x)\}$ and σ_n^β that of $\sum A_n(x)$.

1.2. It was Flett (P.L.M.S. (3), 7 (1957), 113-141) who, for the first time, introduced the notion of absolute summability with index k . Thus according to him a series $\sum a_n$ is said to be summable $[C, \alpha]_k$, $k \geq 1$, $\alpha > -1$, if $\sum_{n=1}^{\infty} |T_n^\alpha|^{k-1} < \infty$ where T_n^α is the n th Cesàro mean of order α of the sequence $\{na_n\}$. Later on he further extended his definition by introducing an additional parameter γ , which states that a series $\sum a_n$ will be said to be summable $[C, \alpha, \gamma]_k$, $\gamma > 0$, if $\sum_{n=1}^{\infty} n^{\gamma-1} |T_n^\alpha|^{k-1} < \infty$ (P.L.M.S. (3), 8 (1958), 357-387).

2.1. Utilising the general principle that the relation of \bar{t}_n^β to $\Psi(t)$ is essentially the same as the relation of $t_n^{\beta-1}$ to $t\varphi'(t)$ and as that of $\sigma_n^{\beta-1}$ to $\varphi(t) \equiv \varphi(t) - 2s$, he (P.L.M.S. (3), 8 (1958), 258-311) proved two sets of inequalities for Fourier series and with the help of some of these results, he obtained a theorem parallel to that of Bosanquet (Theorem 1, P.L.M.S., 41 (1936), 517-528). However it may be observed that although one of his results for conjugate series

generalizes a theorem of Bosanquet and Hyslop (Math. Zeit., 42 (1937), 489-512), his generalization of Bosanquet's theorem to index k is 'less obvious'.

No converse theorem involving necessary condition for summability $|C, \alpha|_k$ has so far been obtained. However there is every possibility that a result analogous to that of $|C, \alpha|$ summability may hold true for it.

Flett has also proved some theorems concerning the summability $|C, \alpha|_k$ of $\sum n^\alpha A_n(x)$, which are analogous to those of Fourier series.

In another paper Flett (P.L.M.S. (3), 8 (1958), 357-387) has studied the summability $|C, \alpha, \gamma|_k$ of Fourier series, the results obtained by him are analogous to those proved for summability $|C, \alpha|_k$. With the help of one of these theorems he has investigated the local property problem for the summability $|C, \alpha|_k$ of the Fourier series of L^p class. In this connection he has obtained a set of results concerning the local property and has shown that his results are best possible. It may be remarked that his theorems generalize, in the case of local property, theorems of Bosanquet, Foà and Tsuchikura and in the case of non-local property, theorems of Bosanquet and Kestelman, Foà, Yano, Tsuchikura and Jurkat and Peyerimhoff.

2.2. In 1959, Yano and Tsuchikura (Tôhoku Math. J. II (1959), 456-479) introduced a modified definition of summability $|C, \alpha|$ with indices k and p . Thus according to them a series $\sum a_n$ is said to be summable $\{C, \alpha\}_{k,p}$, where $k > 0$, $p \geq 1$, if

$$\sum_{n=1}^{\infty} \left(\frac{1}{2^n} \sum_{j=2^n}^{2^{n+1}-1} |T_j^\alpha| \right)^{k/p} < \infty.$$

It has been shown by them that $|C, \alpha|_k \sim \{C, \alpha\}_{k,p}$ for $k=p \geq 1$.

Generalizing a result due to one of the authors (Tsuchikura, Tôhoku Math. J. S., 5 (1954), 302-312), they proved two theorems for Fourier series, their main theorem being analogous to that of a theorem of Flett.

3.1. In order to generalize various results known for summability $|C, \alpha|_k$ and summability $|C, \alpha, \gamma|_k$, Mazhar (Proc. Nat. Inst. Sci. India, 26A (1960), 160-167, Indian J. Math., 2 (1960), 119-124) introduced the definition of summability $|R, \lambda, \alpha|$ with indices k and γ . His definitions are as follows:

A series $\sum a_n$ is said to be summable $|R, \lambda, \alpha|_k$ if

$$\int_0^\infty w^{k-1} \left| \frac{d}{dw} C_\lambda^\alpha(w) \right|^k dw < \infty.$$

where $C_\lambda^\alpha(w)$ is the Riesz mean of type λ and order α , $k \geq 1$, $\alpha > 0$ and $ak/(k-1) > 1$.

And the series $\sum a_n$ is said to be summable $|R, \lambda, \alpha, \gamma|_k$, $\gamma \geq 0$, if

$$\int_0^\infty w^{k\gamma+k-1} \left| \frac{d}{dw} C_\lambda^\alpha(w) \right|^k dw < \infty.$$

It is known that $|R, \alpha, \gamma|_k \sim |C, \alpha, \gamma|_k$ for $\alpha > \gamma - 1/k$.

He has studied various properties of these summability methods (Proc. Math. Inst. Sci. India, 26A (1960), 160-167, Ibid., 27A (1961), ii-17, Indian J. Math., 2 (1960), 119-124) and has investigated their application to infinite series (Abstract to be published in Proc. ISCA, 1962).

Generalizing a number of theorems due to Matsumoto (Tôhoku Math. J., 8 (1956), 114-124), Mazhar (In an unpublished paper) has obtained the following theorems for factored Fourier series.

Theorem A. If

$$\int_0^t |\varphi(u)| du = O\left\{t/\log \frac{k}{t}\right\},$$

k being a suitable constant, then the series $\sum \frac{A_n(t)}{\left\{n^\Delta \log(n+1)\right\}^{1/k}}$, at $t=x$, is summable

$|R, e^{\frac{\Delta}{n}}, 1|_k$, where $k \geq 1$, $0 < \Delta < 1$ and $\epsilon > 0$.

Theorem B. Under the hypothesis of Theorem A, the series $\sum A_n(t) / \{(1+n)^{\frac{\Delta+\epsilon}{k}} \log n\}$, at $t=x$, is summable $|R, e^{(\log n)^\Delta}, 1|_k$, where $k \geq 1$ and $\Delta > 0$.

Theorem C. If

$$\int_0^t |\varphi(u)| du = O\left\{t/\log \frac{k}{t} \log \log \frac{k}{t}\right\},$$

then the series $\sum \frac{A_n(t)}{\{\log \log(n+1)\}^{\Delta+\epsilon/k}}$, at $t=x$, is summable

$|R, e^{(\log \log n)^\Delta}, 1|_k, \Delta > 0$.

He has further shown that in the case $k=2$, these theorems can be proved even under a lighter condition, namely

$$\int_0^t |\varphi(u)| du = O\left\{t/\log \frac{k}{t}\right\}^\alpha, \alpha > \frac{1}{2}$$

II. MAGNETO-HYDRODYNAMICS

Chairman : DR. P. L. BHATNAGAR, Bangalore.

1. C. DEVANATHAN (Bangalore) : Oscillations of a Three Component Assembly with or without magnetic field.

The plasma is taken to be composed of singly ionized molecules, free electrons and neutral molecules, each of the component being described by the hydro-magnetic equations, modified to take into account the displacement current, existence of free charge in the medium, and the modified current equation without involving the scalar conductivity. The basic equations are linearized and only small amplitude waves are considered. In the absence of any external magnetic field, the transverse and longitudinal modes of oscillation separate out. In the transverse part a coupled plasma oscillation occurs which could be propagated only above a certain critical frequency and in the longitudinal part one extraordinary mode of propagation occurs having a forbidden range of frequencies.

When there is an external applied magnetic field, ordinary and extraordinary waves are propagated along the direction of the magnetic field, whereas only ordinary waves are propagated transverse to the magnetic field. The critical frequencies above which these waves are propagated are evaluated and the possible explanation of this medium like behaviour could be the implicit assumption of conductivity being not a scalar.

2. P. L. BHATNAGAR and C. DEVANATHAN (Bangalore) : *Generalized B-G-K Collision Model and Oscillations of a three-component Assembly.*

The BGK collision model for one component assembly of neutral particles has been extended to two component assembly of charged particles by Gross and Krook and later on modified by Bhatnagar. Following the lines of latter, the model has been generalized to N-component assembly of both charged and neutral particles. This model is further applied to the study of small amplitude plasma oscillations in an assembly consisting of ions, electrons and neutral particles in the direction perpendicular to a uniform magnetic field. The dispersion relation splits up into two, one determining the transverse oscillations and the other longitudinal oscillations. In the transverse oscillations for small wave numbers k , it has been shown that apart from the Gross gaps occurring at the multiples of gyrofrequencies of electrons and ions, if the magnetic energy density M is greater than one-third the kinetic energy density K of charged particles, and terms only upto k^3 are retained, five more forbidden ranges of frequencies occur. If $M < \frac{1}{3} K$, the number of additional gaps reduces to three. When $M=0$, Oster's result is obtained as a particular case. The oscillations of neutral particles excited by collisions are strong at low frequencies, whereas for high frequencies they are mostly damped out. Longitudinal propagation has been studied under very restricted circumstance numerically and it is shown that, unless the magnetic field is very high, propagation is possible for all frequencies. For sufficiently high magnetic field when the Alfvén velocity is comparable with the velocity of sound, there is one forbidden range.

3. A. J. DESSLER (Ahmedabad) : *Ionospheric Heating by Hydromagnetic Waves.*

The propagation of hydromagnetic waves through the magnetosphere and ionosphere has been studied in some detail. It is found that for wave frequencies above about 0.1 cps, a significant fraction of the wave energy is dissipated in the ionosphere below 300 km altitude. Some details of the hydromagnetic dissipation mechanism will be discussed and some possible consequences of hydromagnetic heating will be pointed out.

4. K. R. RAMANATHAN (Ahmedabad) :

K. R. Ramanathan presented the results of certain observations on electron density at high altitudes (from 10,000 to 50,000 kilometres) subsequent to the sudden commencement of magnetic storms and solar flares. A few hours (two to three) after the commencement, the electron density decreases rapidly as the altitude increases and in certain observations becomes practically nil (within the accuracy of the experiments). Immediately after electron density slowly increases and in almost all cases attains again its normal value in about two days. He further remarked that similar observations had been made from satellites orbiting at those altitudes and they confirm the same tendency.

5. T. PRADHAN (Cuttack) : *Causality and the Dispersion Formulae for Waves in a Plasma.*

The principle of causality which states that the effect cannot precede the cause, is invoked to obtain the correct prescription for integrating across the pole in the dispersion formulae for the longitudinal and transverse waves in a collision-free plasma obtained by the simultaneous solution of Maxwell's electromagnetic and linearised Boltzmann's transport equations. Conditions for growing and decaying waves are obtained from the results that follow from the above prescription. An analysis of the nature of the initial disturbance is also given.

6. R. K. RATHY (Kanpur) : *Steady Flow of a Conductivity Fluid in the Annular Space between two co-axial cylinders under transverse magnetic field.*

Hartmann's problem for a circular pipe has been investigated by Ya. S. Uflyand.

In the present paper the steady flow of a finitely conducting fluid in the annular space between two co-axial cylinders when one is moving parallel to its axis, under a transverse magnetic field is investigated. The velocity field is found to be symmetrical about the plane passing through the axis of the cylinders and parallel to the external magnetic field, while the walls are assumed to be non-conducting.

I. CONTROL OF ERRORS IN SAMPLE SURVEYS

Section of Statistics

Chairman : DR. C. CHANDRASEKARAN, Bombay.

1. M. A. TELANG (Bombay) : *Sampling and Non-Sampling Errors.*

There is need for proper supervision work over the collection of data for a sample survey. Provision should be made for well paid and qualified staff in the basic work of a survey organisation. Forms and schedules should be very carefully designed and drafted keeping in view the future processing of the collected data and realisation of the formulated objectives.

2. R. K. SOM (Calcutta) : *Control of Non-sampling Errors and Interpenetrating Sub-samples.*

Of the two types of errors, sampling and non-sampling, the sampling error is sought to be controlled by proper stratification and selection at different stages. The importance of the assessment and control of non-sampling errors, which may, and do, co-exist with sampling errors, has started to be recognized comparatively, recently. In data affected markedly by non-sampling biases, the sampling error alone would be a poor guide. It should, however, be emphasized that the chance and the magnitude of non-sampling errors are likely to be more in a complete enumeration ("censuses"). In 1937, Mahalanobis introduced the technique of interpenetrating sub-samples (I.P.N.S.) in surveys conducted by the Indian Statistical Institute and this technique is now applied in the sample design of the National Sample Survey (NSS). The technique of I.P.N.S. enables one to separate out the investigator variance from the sampling errors (Mahalanobis,

JRSS, 1946, Japan lectures 1958; Som, Sankhya (1962); NSS Report No. 48). A wider application in the control of errors by I.P.N.S. can be made in processing and also in bacteriological and X-Ray examinations in health surveys. Another control, also in the form of I.P.N.S., is built in the NSS and at present almost all the states participate in the NSS on a machine basis (Mahalanobis and Lahiri, Inter State Conf., 1960).

It is suggested that in a uni-purpose survey, the non-sampling errors would be easier to control and eliminate. This seems to be an irrelevant and misleading statement. All the surveys mentioned earlier, except the NSS, were uni-purpose surveys. In a uni-purpose demographic survey, the whole of the mortality data had to be rejected because of non-sampling errors! On the other hand, a multi-purpose survey may be preferred because of better utilization of scarce resource and better rapport with the people.

3. S. P. MUKHERJEE (Calcutta) : *Scrutiny of Working-Sheets by Control Charts.*

With manual tabulation, errors are likely to arise in the transcription of information on the questionnaire to the working sheet. To assess the accuracy, sample checks may be called for. An objective procedure has been suggested by which to judge from sample checks whether or not to examine an entire schedule for the case of m transcribers each working with a schedule containing k items of information for each of l units. The method consists in preparing a group control chart for fraction defective, each item being treated as a subgroup, the fraction defective being computed from a random sample of units. Varying numbers of units have been considered and the method extended to the case of a transcriber handling a number of questionnaires.

4. P. K. BOSE (Calcutta) : *Preventive Detection of Errors.*

Preventive detection of error is more important than cure or control of errors in sample surveys. It is good to work out rectification formulas or rules for cure of committed errors. But it is perhaps better to have vigilant team of workers posted in all important positions of a survey organisation. The workers of these levels should be well qualified and well paid.

5. K. V. RAMACHANDRAN (Bombay) : *Control of Non-sampling Errors in Sociological Surveys.*

Of the two broad groups of errors which enter into sample estimates the sampling errors and the non-sampling errors are important. Several techniques and methods are available to take care of the former whereas the non-sampling error, a part of the total error in the estimate, has received attention only recently. Several sources of non-sampling errors are enumerated; but we are here concerned with one type of non-sampling error which is usually important especially in large scale sociological type of enquiries and that is the personal error or bias introduced in sample surveys.

For a given cost if the sample size is increased the sampling error is reduced, whereas the non-sampling error is increased. Thus unless the budget is unlimited, in large scale inquiries especially of a sociological nature, the non-sampling error could play a very important role and the investigator error may play a very important part in it. Since different methods of sampling are available to take care of the different situations which will reduce the sampling error, part of the

total error, the planner of surveys should design the survey in such a fashion that at least he may be able to estimate the interviewer differences and biases under certain conditions. Thus the detection of these errors should play an important part in the designing of a sample survey so that appropriate controls may be applied. The interpenetrating and interlocking method of sampling propounded by Prof. Mahalanobis to a certain extent take cognisance of the problem but the operating characteristics and other properties of the sampling methods should be investigated. Some work has been done at the Demographic Centre, Bombay, but more remains to be done.

6. LAKSHMI VENKATARAMAN (Bombay) : *How to Avoid Non-Sampling Errors.*

The only suggestion that I have to make is concerned with the control of the non-sampling errors. The extent to which the personal bias of the respondent, affects the information given by him—this is one of the sources of non-sampling errors—could be reduced by modifying the method by which this information is obtained from the respondent. Take the case study of a readership survey conducted in the U.S.A. where an obviously inflated figure was obtained for "respectable" magazines like *Life*, *Fortune*, etc. Whereas readership figures for magazines like *Romances*, *True Confessions*, etc., were very much under estimated. Here the method of getting the required information was improved by requesting the housewives to give all the old magazines in the house. So that they could be used in a charitable institution and thus finding out as to what magazines are actually brought in the house. This would be a better technique which will give a more accurate picture of what magazines are actually bought. Thus refinement of schedule design and method by which information is obtained is an important area whereby non-sampling errors could be controlled.

7. P. K. PATHAK (Calcutta) : *Simple Random Sampling.*

In simple random sampling with replacement Basu (1958), and Des Raj and Khamis (1958) have shown that for estimating the population mean, the average of distinct units is more efficient than the overall sample mean. In this paper, a detailed treatment of the above problem is given, and an estimator has been found which has smaller variance than the well-known Horvitz-Thompson estimator. Some unbiased estimators are suggested and their relative performance is studied with the help of a numerical example. An improved estimator of the population variance is also derived. Lastly, a comparison between the two simple random sampling schemes (with and without replacement) is made for the purpose of estimating the population mean.

8. N. K. D. CHAUDHURY (Roorkee) : *Estimation of Unreported Births and Deaths.*

The estimation of the unreported deaths and births is an important problem. If good estimates were found, the figures could be used for checking the comparability of two consecutive census estimates.

9. V. V. B. RAO (Bombay) : *Personal Bias in Sample Surveys.*

Apart from the recall error from the informant's side in non-sampling errors, there is the informant's personal bias. The model used for recall errors, for

example, cannot be used in the case of sex Ratio errors. Because this error arises out of informant's personal bias, one cannot say that the under-enumeration of the females is not an aspect of re-call error but informant's personal bias. Perhaps, one way of controlling this error is convincing and educating the people in the ways of surveys.

10. S. R. KULKARNI (Dharwar) : *People's Co-operation in Sample Surveys.*

There should be a proper education programme for the respondents of a survey. People should be made to understand all the various purposes of the survey, and this is by far the best way of controlling the non-sampling errors.

11. R. GIRI (Delhi) : *Wastage of Resources in Sample Surveys.*

Crowding of the schedules with numerous items in multi-purpose surveys contribute to large non-sampling errors. This leads to unreliability of the results obtained. Even a multi-purpose survey should not be so 'multi-purpose' that a particular group of investigators with their limited knowledge and experience and training might not be in a position to do justice to all the items. In multi-purpose survey in which items occur frequently are usually estimated with much larger precision than needed, and items with low frequency, with high sampling error. This one should consider as wastage of resources.

12. A. P. BHATTACHARYYA (Roorkee) : *Respondent Bias in Sample Surveys.*

Some inaccuracies inherent in the standard methods employed in sample surveys in the form of eliciting information by replies to questionnaires are worth noting. An example may be given from the results of an analysis of benefits of a canal irrigation in the commanded area of a major canal system of Uttar Pradesh (Sarda Canal System). A sample survey was conducted by the Economics Department of the Lucknow University. It was found that 97% of the cultivators had replied that high irrigation rates were impeding the development of canal irrigation, while 99% had replied that inefficiency was the main cause. Obviously the results had to be judged with caution and the element of bias in the above mentioned replies could not be ruled out.

II. NUMERICAL ANALYSIS AND MODERN COMPUTING DEVICES

(Jointly with Sections of Mathematics, and Engineering and Metallurgical Sciences)

Chairman : DR. P. L. BHATNAGAR, Bangalore.

1. L. K. WADHWA (New Delhi) : *Simulation of Third Order Systems with One Operational Amplifier.*

The third order linear system simulation by electronic analog computers is generally done with two or more operational amplifiers by techniques that are very well known.

A method has been discussed in this paper which shows that third order linear systems can be simulated with the aid of only one operational amplifier and a few two-terminal impedance consisting of resistors and capacitors only.

Three possible circuits capable of simulating a particular case of the general third order linear system have been presented and the resulting third and fourth order non-linear algebraic equations have been solved for determining the validity conditions and the circuit component values.

The method of simulation is simple. If the validity conditions are satisfied then a physically realizable network consisting of one operational amplifier, three capacitors, five resistors exists and the component value may be easily calculated from the equations developed in the text.

2. L. K. WADHWA and JAGDISH CHANDRA (New Delhi) : *One Operational Amplifier Simulator for a Third Order System with a Leading Time-Constant.*

In another paper presented in this symposium one particular case of a general third order system was considered. In this paper another case of the general third order linear system with one leading time-constant is considered.

Only three of the possible sixteen circuits are discussed in the text. The circuits given in the text have been analysed and the resulting third degree non-linear algebraic equations have been solved with a view to determining the validity conditions and the component values.

The method of simulation is simple. If the validity conditions are satisfied then a physically realisable network consisting of one operational amplifier, four capacitors and four resistors exists and its component values may be easily calculated from the equations developed in the text.

3. P. K. BOSE (Calcutta) : *Time Honoured Techniques of Computation.*

There is no doubt a strong need for development of computer equipments in various centres of scientific and technological research in our country, but the workers should not forget the time honoured methods, particularly in cases where their data are of manageable size. Individual researchers should always make it a point to master some of the standard techniques known so far to be quite suited to manual computing machines. Before the modern computer devices are taken into use, the workers should make a thorough study of their limitations. Good points of results obtained through relaxation or incomplete integral equation methods should be taken into consideration.

III. STATISTICAL METHODS IN MEDICAL SCIENCES

(Jointly with Section of Medical and Veterinary Sciences)

Chairman : DR. J. C. BANERJEA, Calcutta.

1. K. K. MATHEN (Calcutta) : *Statistical Methods in Medical Sciences.*

In taking up the subject of drawing inferences from statistical data collected we may think of two kinds of situations. On the one hand, the investigator wishes to know whether the statistics he has collected are compatible with certain theories he had with regard to the true state of affairs. On the other hand, the

public health worker or clinician has to make certain decisions such as stopping a clinical trial because the results achieved are too poor to justify its continuation or to decide whether the patient at a certain stage of the disease should be operated or not taking into account the risks involved. In either case the doctor's decision is associated with elements of risk. An essential function of statistical methods is to measure this uncertainty and in order to fortify statistical inference in such situations the Theory of Probability has been developed and utilized by the statistician.

We may state here some of the important uses of sampling technique in the medical and public health fields. It is well known that study of a sample is more economical than a complete study of the population. Generally, it is more speedy. But a less well recognized advantage of sampling method is that in many instances complete study or enumeration of the population is not only less accurate than the sample study but even impracticable. A very good example from clinical medicine of the impossibility of a complete study of the population is the laboratory diagnosis of a patient based on the examination of a few drops of blood. The procedure is based on the assumption that the circulating blood is always well mixed and that one drop tells the same story as another. Other good examples in public health practice are the sample examination of food produced in an establishment of milk produced in a dairy and the sample examination of water in a water supply plant.

To test whether the evidence from two independent samples relating to two treatments suggests that the treatments have different effects, we assume the opposite proposition to hold viz. that the two treatments have the same effect. Using probability and sampling theory we calculate the probability for obtaining results noted. If this probability is smaller than a standard level (chosen according to the situation) then following the 'Reduction to Improbability' argument, we reject the hypothesis.

2. V. N. AMBLE (Delhi) : *Statistical Methods in Animal Sciences.*

Applications of statistical theory and methods to animal research particularly with large animals are varied and interesting involving as they do both experimental and survey situations and presenting at the same time a number of complications owing to factors such as considerable animal to animal variation, a low reproduction rate, long generation interval, limited availability of experimental material etc. The applications may be conveniently divided into those concerning (i) animal genetics and breeding, (ii) animal nutrition and management problems, (iii) problems concerning control of animal diseases and pests, (iv) standardisation of procedures of sampling and measurement techniques and (v) estimation surveys for assessment of existing situation and progress.

In many fields of animal experimentation sampling has to be resorted to for securing the required data. For example the estimation of milk production in a village cattle development scheme can only be done on the basis of records of milk yields on a sample of days during the lactation of a selected sample of animals in milk in the population under the scheme. Similarly in any research on wool improvement, a sound procedure for sampling the fleece is necessary for assessing the quality attributes of wool. Statistical techniques are not only necessary in developing suitable sampling procedures but also in further standardisation of procedures of measurement of diameter, fleece density, etc.

Finally statistical techniques are needed in conducting surveys for assessment of existing situation of progress. The I.A.R.S. has been engaged of late in developing random sampling techniques for estimation of livestock numbers, amount of marine fish catch and livestock products such as milk, wool and eggs. The

Institute has also evolved a technique for estimation of cost of production of milk and carried out surveys for the purpose in Delhi, Madras and Calcutta. The statistical assessment of the progress of rinderpest eradication campaign undertaken by the Government of India on a countrywide scale well illustrates the role a statistician can play in controlling the operational efficiency of a large scale programme.

3. A. B. L. SRIVASTAVA (Meerut) : *Statistical Approach to Medical Diagnosis.*

A medical diagnosis does not in general represent a hard fact; it only represent a physician's judgment and opinion. As such it has been felt necessary to use only objective measures of patient function such as temperature, blood pressure, X-Rays etc. for diagnosis. It makes a mathematical approach to the problem possible.

Two Models that realistically represent the processes actually employed by the physicians in diagnosing disease have been suggested. (i) *Discriminant function model*—Each sign or symptom is given an empirically derived weight and a single artificial mathematical measure is obtained as the sum of separate weighted values. (ii) *Frequency count model*—The relative frequency of occurrence of each possible symptom-disease pattern is considered. Electronic computers can be programmed and worked to determine the most appropriate diagnosis in a certain case by making use of the factual data relating to a patient's symptoms. The methods used in certain studies made in American Institutions show how the propositional calculus can be employed to work out symptom—disease complexes, from which in a logical way the disease can be diagnosed.

4. A. K. GAYEN (Kharagpur) : *Need for Facilities of Studies and Research in Medical and Bio-Statistics.*

Our research laboratories should develop Divisions of Statistics to deal with application of mathematical and statistical methods in various branches of medicines and biology and other allied science. Researches in (i) Epidemiology and Aetiology of disease, (ii) Design and analysis of therapeutic trials and new drugs and other agents, (iii) Field trials of prophylactic agents, (iv) Experimental methods in biological assay etc. will come in its purview. Such Divisions should be entrusted with the collaborative work in problems of a statistical and observational nature that are encountered by the research workers belonging to all the various allied fields of Medical and Biological research.

The science of Statistics is rather of recent origin. All its important developments were made in the first few decades of this century. The literature that have grown specially on the problems of Medicines and Biological Sciences, tackled with mathematical and statistical tools, are of fairly high standard and are largely the contributions of workers (Statisticians) attached to high grade medical research Institutes of Western countries. We have to work hard and devote considerable attention to keep abreast with the up-to-date development of techniques and tools of research, to be able to produce results of real value in the field. Every effort must be made to utilise the resources that are available here to build up a body of workers to shoulder the responsibility of organising researches and investigations in the field and to see that the level of efficiency of the activity and the standard of contribution compare well enough with those of the other advanced countries of the world.

Research workers in the field of medical statistics have found so far the concepts and tools of the most important branches of Sciences, viz. Physics and Chemistry, very useful in their investigations. But to-day the usefulness of Statistics

in their work is perhaps stronger because, the past few decades have found development in Physics and Chemistry themselves to be much dependent on the theory and practice of Statistics, a comparatively new scientific discipline. Whether we like it or not, once a Science advances beyond the descriptive stage, its problems become somewhat statistical. As the application of concepts and tools of Physics and Chemistry in the study of Biological and Medical investigations have resulted in the development of two somewhat distinct branches of applied Science, viz., Biochemistry and Biophysics, so the applications of modern statistical ideas and techniques have contributed towards the building up of another very useful branch of applied science, viz., Bio-statistics.

5. DR. B. MUKHERJEE, the General President of the Congress, attended the symposium, and made a strong plea for active cooperation of workers of Biological Sciences and Mathematics and Statistics. He dwelt on the quantitative aspects of the present day investigations in pharmacology and biology and the fruitful uses of statistical methods.

RADIO AND MICROWAVE SPECTROSCOPY

Section of Physics.

Chairman : PROF. VIKRAM A. SARABHAI, Ahmedabad.

1. D. V. G. L. NARASIMHA RAO (Waltair) : *Electron spin resonance in Gamma Irradiated single crystals of some Organic Compounds.**

A study of the electron spin resonance spectra is now an established method for investigating the free radicals produced by x- or gamma irradiation. A large number of organic chemicals has been investigated in the powder form at room temperature as well as at low temperatures. Though the free radicals induced by the radiation can sometimes be identified, there is always an uncertainty in the conclusions drawn due to the anisotropy in the g- factor or the nuclear hyperfine coupling constant. On the other hand, by investigating the spectra of the sample in the form of a single crystal, one can obtain more information about the anisotropies in the g- value and the hyperfine splittings. Further, conclusions regarding the nature of the radiation induced free radical will be more reliable. The importance of such investigations has been realised only recently and already results on a few single crystals have been reported by McConnell, Gordy, Whiffen and others.

Detailed analysis in the case of urea oxalate, DL-tartaric acid and its deuterated derivative, for which the author has carried out measurements at X (9 kmc/s) and K (23 kmc/s) bands for all orientations in the external magnetic field, will be presented. In both the cases weak lines due to second order transitions corresponding to the simultaneous flipping of the electron and the nuclear spin of the hydrogen have been detected and could be explained theoretically.

2. DR. C. N. R. RAO (Bangalore) : *Chemical Applications of nmr Spectroscopy.*

Applications of nuclear magnetic resonance spectroscopy in the elucidation of structures of compounds particularly, natural products, in the study of hydrogen bonding, in the study of conformational equilibria in cyclohexane derivatives, and in reaction kinetics will be reviewed.

* Work performed in the Microwave and Radiofrequency Laboratory, Duke University, Durham, N.C., U.S.A.

3. B. VENKATARAMAN (Bombay) : *Hyperfine Structure Investigations in Electron Spin Resonance of Organic Free Radicals.*

Proton hyperfine structure observed in the ESR of organic free radicals containing π -type odd electron system has been the subject of investigation by several workers. The experimental results obtained and the information they have given regarding the structure of these free radicals are briefly discussed. Satisfactory theories have been proposed to explain these experimental results and the latest theories attempt to give the value of the density of the unpaired electron at the ring-carbon of an aromatic free radical. The experimental results obtained on C^{13} -labelled compounds and also on C^{13} in natural abundance, will be presented.

4. P. PARIKH (Gujarat) : *Dynamic Nuclear Polarisation in free Radical Solution.*

The method of dynamic nuclear polarisation (as first suggested by Overhauser¹) is employed to enhance the weak nuclear signals available in very low magnetic fields. The interactions studied in these experiments were of the dipole-dipole type which existed between the free electrons of the radical and the protons of the solvent substance. In case of an aqueous solution of the free radical $(SO_2)_2NO$ —the enhancements of the proton signals on simultaneously exciting the electron resonance of one of the eight possible hyperfine structure transitions are studied in very low magnetic fields (between 0.3 Oe to 20 Oe). The method also allows a study of the nature of the interaction between the free electrons of the dissolved Asphaltene radical and protons of the surrounding lighter hydrocarbons of the liquid in natural crude oil.

The apparatus is capable of registering the nuclear magnetic resonance signals with and without the enhancement by the effect of dynamic polarisation. The required sensitivity is achieved by employing a modified Q-meter²) along with phase sensitive detection where rapid-field modulation method is applied. Precise measurements of low magnetic fields could be made and a nuclear magnetic resonance MASER* could be operated in the whole range of the magnetic fields.

5. V. SUBBA RAO (Andhra University) : *Some Applications of Molecular Beams.*

This paper is primarily concerned with the applications of the technique of molecular beams to determine certain magnetic properties of complex molecules, such as the mean magnetic moment of the complex. Making use of their deflection properties in inhomogeneous magnetic fields, values have been obtained for dissociation energies of these complexes into their two basic components.

Alkali halides, when heated together with divalent halides of Fe, Co, Ni form complexes of the type $KClFeCl_2$. The complex is the dominant detectable species by the positive ion detector, which is invariably used in all the magnetic machines, in the vapour phase. These complexes are characterised by virtue of their mean magnetic dipole moments which are much larger than the nuclear magneton and much less than the Bohr magneton while the alkali halide has a very small magnetic moment of the order of a nuclear magneton.

¹ A. Overhauser, *Phys. Rev.*, **92**, 411 (1953).

² W. Miller-Warmuth and P. Parikh, *Bulletin Ampere*, **9**, 680 (1960).

³ W. Miller-Warmuth and P. Servoz-Gavin, *F. F. Naturforsch.*, **13a**, 164 (1958).

* MASER—An acronym for Microwave Amplification by Stimulated Emission of Radiation.

6. DR. S. S. SRIVASTAVA (New Delhi) : *Rotation Spectra of Long Chain Molecules in Radio and Micro Wave Band.*

The rotational spectra of Phthalates has been observed in Radio and Micro Wave Band by determining the distribution of dielectric loss with frequency extending over a band of 100×10^8 c.p.s. to 2.64×10^{10} c.p.s. The absorption has been measured in several non-polar solvents by specially designed cavity resonators. The $\tan \delta - \log f$ closely fits in with the theoretical curve $\tan \delta = 0.0857 \text{ Sech } \log fm/f$ with a maximum at a frequency 3.29×10^9 c.p.s. which is considered to be due to the rotation of the molecule around its longitudinal axis since symmetry of the molecules along the horizontal rules out such movement. The paper presents measurements carried out in radio and micro wave band on a number of long chain molecules.

7. DR. (MISS) P. R. K. L. PADMINI (Visakhapatnam) : *Study of Ultrasonic velocity dispersion and absorption in High Polymer solutions.*

Ultrasonic velocity studies are carried out in organic solutions of various fractionated samples of polyvinyl acetate, cellulose acetate and Ethyl Cellulose. The parameters adiabatic compressibility, apparent molal compressibility and apparent molal volumes are calculated and their variation with concentration and molecular weight is studied. Dispersion of ultrasonic velocity is studied in Benzene solutions of four fractionated samples of polyvinyl acetate and acetene solutions of three fractionated samples of Cellulose Acetate. A velocity dispersion of 100 m/s in polyvinyl acetate solutions, and a dispersion of 25 m/s in cellulose acetate solutions is observed in the frequency range 1 to 5 mc/sec. Absorption studies are carried out in Benzene and Acetene solutions of unfractionated and fractionated samples of polyvinyl acetate and unfractionated sample of cellulose acetate. The results are interpreted in the light of the existing theories of absorption.

I. CYTOGENETICS OF POLYPLOIDS

Section of Botany

Chairman : PROF. J. VENKATESWARLU, Waltair.

1. P. N. MEHRA (Chandigarh) : *Polyploidy and Evolution.*

Information has been presented on the incidence of polyploidy in different groups of land plants. Ferns show the maximum polyploid percentage being of the order of 45.4% amongst the investigated taxa. Certain genera and groups like *Selaginella*, members of the Osmundaceae, Anthocerotales, Cycads and Conifers are averse to polyploidy. It is suggested that they lack the inherent potentiality or genetic fit to bear the load of polyploidy for the maintenance of their physiologic efficiency and survival in nature. Their normal chromosomal set is already in a state of saturation within the cytoplasm in which they are lodged for their maximum efficiency unless in exceptional circumstances when a particular genetic combination of a multiple set may override this general effect. The cytogenetical factors operating in the evolution of taxa of different categories are identical in different plant groups. Autopolyploidy though distinctly operative is much less potent than segmental polyploidy or allopolyploidy in differentiation of species. The role of

allopolyploidy in conjunction with chromosomal alterations including gene mutations, particularly at the dibasic level, in differentiation of taxonomic categories above the species level seems to be much more than so far realised as deduced from circumstantial evidence. The geographical significance of frequency of polyploidy has been considered in its wider perspective in terms of different factors like age, intrinsic potentialities, breeding mechanisms, opening of new niches etc. in different plant groups. In ferns the rate of polyploid evolution is faster in tropics than elsewhere. In other Pteridophytes, which are also inhabitant of tropics, the degree of polyploid evolution achieved is much higher than in any other group of plants because of their age.

2. R. K. JANAKIAMMAL (Jammu-Tawi) : *Polyplody in Relation to Adoption and Extension of Habitats.*

A comparative study of chromosome numbers of the families of flowering plants, shows that the prevailing basic numbers in many "Natural Orders" are allopolyploid derivatives of smaller complementary chromosome complexes found in related families. The ancestral chromosome relationship is sometimes preserved by the survival of a few genera with these numbers in families like Loganeaceae.

It is thus very probable that families originated in definite are as by hybridization followed by chromosome duplication, and spread rapidly over the earth during geologic periods when the climate was more equable and the surface flatter than it is to-day.

With the advent of eras of mountain building which was followed by glaciation and later by desert conditions many species became extinct while others withstood environmental changes by chromosome changes involving polyploidy. Both auto- and allo-polyploids show differences in morphology from their diploid progenitors. These differences can give the polyploid ecological advantages over the diploid allowing the polyploid to replace the diploid as well as to colonize. New climatic and edaphic situations free from competition. With the retreat of ice in the Northern Hemisphere, species, isolated, have been brought together for further hybridization and polyploidy and in this way a new era of polyploidy initiated in specific regions, chiefly peripheral areas of the diploid. This has been the case in such genera as *Primula*, *Rosa* and many others in which polyploids have migrated latitudinally from their ancestral homes.

In *Rhododendrons* the new polyploid as a result of physiological benefits derived by polyploidy have come to occupy altitudes that no other flowering plants have attained on the Himalayas.

A detailed analysis of the relationship between altitude and polyploidy in species of *Rhododendron* is presented.

3. M. S. SWAMINATHAN (New Delhi) : *Cytogenetic Mechanisms involved in the Diversification and Stabilisation of Polyploids.*

The polyploid plants occurring in nature represent a continuous spectrum of variability in their cytogenetic properties, ranging from inter-varietal autopolyploidy to strict genomic allopolyploidy. A vast proportion of polyploids occupy an intermediate position between these two contrasting categories. This is natural since a combination of the desirable features of autopolyploidy (i.e., polysomic constitution at loci showing additive effect) and genomic allopolyploidy (i.e., regular meiosis) would confer the maximum advantage to the plant. The extent to which this process has proceeded in different plants varies depending upon the type of natural and human selection that have been in operation and the scope available for subsequent hybridization and introgression.

The genetic stability of a polyploid can be achieved through either apomixis (including vegetative propagation as in the case of *Solanum tuberosum*, *Ipomoea batatas* etc.) or mechanisms designed to ensure cytological diploidy. To the latter class belongs the very interesting recent discovery of the operation of a multivalent suppressor gene system in *Triticum aestivum* and the various modes of configurational regularisation of chromosome disjunction. Extensive chromosome re-patterning and chromatin elimination also take place in polyploids contributing to morphological diversity and genetic diploidisation.

Besides introgression which is an important factor in the diversification of polyploids, polyploidy provides the wherewithal to withstand the occurrence of macro-mutations, which at a single step may lead to the origin of supra-specific taxonomic categories. Macro-mutations, which are seldom viable in diploids, survive more readily in polyploids and their role in engendering new variability should be critically assessed.

A comparative study of naturally occurring and synthetic allopolyploids shows that while even apparently worthless genomes combine to produce a superior genotype in the former category, most new synthetic genome combinations prove to be unstable and inviable. This illustrates that coherence rather than individual merits contributes to the stability and adaptive virtues of an allopolyploid.

4. K. N. NARAYAN (Mysore) : *Apomixis and Polyploidy.*

Recent reports have revealed that more than 200 species of angiosperms reproduce by means of apomixis. Of these 200 or more species, Gramineae alone has about 86 and Compositae comes next with about 65 forms. A large number of these apomicts are polyploids, a fact which indicates that there is a close association between apomixis and polyploidy. Such an association of apomixis and polyploidy has prompted some authors to postulate that polyploidy initiates apomixis. Although evidence for such a view is not very convincing there is evidence to show that polyploidy stabilises and promotes apomixis.

Adventitious embryony is the one type of apomixis that is more commonly seen in the diploids, while gametophytic apomixis is very rarely seen in them. Stebbins mentions only three groups of diploid plants with gametophytic apomixis viz.—*Potentilla*, *Ranunculus* and *Heiractum*. Among grasses only one diploid, *Pennisetum ramosum* $2n=10$, was known to exhibit a tendency towards apospory. In recent years two more diploid grasses *Pennisetum hohenackeri* $2n=18$ and *Panicum antidotale* $2n=18$ have been shown to be aposporous. The latter has two forms, a diploid with $2n=18$ and a tetraploid with $2n=36$. Apospory seen in these two forms is interesting in that in the diploid it is of a low frequency while in the tetraploid it shows a high frequency. In addition the tetraploid is also diplosporous. This relation of an increasing degree of apomixis with an increasing degree of polyploidy supports the view that the action of genes producing apomixis is more pronounced at the polyploid level than at the diploid level. Good evidence for such a relation between polyploidy and apomixis is available in ferns and in some viviparous angiosperms.

5. S. V. S. SHASTRY (New Delhi) : *Secondary Polyploidy—Occurrence, Detection, and Significance.*

Difficulties encountered in the classification of polyploids are due to the variable primary unit of evolutionary change which may be a genome, a chromosome or a chromosomal segment. Secondary polyploids owe their origin to extra dupli-

cation of one or more chromosomes in one or more genomes of a polyploid and are a wide occurrence in angiosperms. The detection of chromosome number which is not a multiple of the basic number by itself does not constitute an evidence for secondary polyploidy since the fragmentation and fusion of chromosomes could lead to the above effects. Since the phenotypic characters of the organism not only depend upon the sum total of genes, but also upon the balance between the genes with opposing action, strict secondary polyploids are likely to affect the balance while the "apparent secondary" polyploids (fusion and fragmentation products) may not do so. Extensive occurrence of this type of polyploidy indicates that at least a small part of these changes which occur in nature are adaptive, are favoured by natural selection and constitute a progressive force in evolution.

The standard methods of detection of secondary polyploidy are by the study of chromosome numbers, secondary association, autosyndetic pairing in haploids and interspecific hybrids, and increase in the number of bivalents and trivalents in a triploid hybrid. Every one of these methods have their own limitations. Chromosome structural changes in some cases mimic the secondary polyploidy. Genetic evidence of polysomic segregation in functional diploid organisms constitutes an independent evidence but even this criterion sometimes is misleading, since chromosome structural hybridity by way of cryptic differentiation can lead to wide disturbances in genetic ratios which might be wrongly interpreted as due to polysomic inheritance. In view of the above limitations in the methods of detection, independent and corroborative evidence from as many different methods as possible might constitute a reasonable proof of secondary polyploidy. The reported cases will be critically evaluated from this stand point.

6 R. P. ROY (Patna) : *Genomic Studies in some Triticum-Aegilops Amphidiploids.*

In this discussion is included the behaviour of only a few of the amphidiploids involving some species of the genera *Triticum* and *Aegilops* with a view to throw some light on the genomic nature of the species concerned. The amphidiploid *T. aegilopoides* X *A. bicornis* is particularly useful from this point of view. It is generally held that species whose genomes are dissimilar show no pairing of chromosomes in F_1 hybrids but normal bivalent formation in the derived amphidiploids. Intergeneric F_1 hybrids and amphidiploids normally satisfy these criteria. Yet in the genera *Aegilops* and *Triticum*, there are F_1 hybrids which always show some amount of chromosome pairing, but the derived amphidiploids have only bivalents and possess normal fertility confirming the Darlington's Concept of "preferential pairing". In the *T. aegilopoides* X *A. bicornis* there are ring bivalents in F_1 and high percentage of PMCs show quadrivalents in the derived amphidiploid. It may be remembered that the genome of *T. aegilopoides* being AA, (this species is considered to be the donor of A genome to the tetraploid and hexaploid wheat) is quite dissimilar to the genome S^bS^b of *A. bicornis* (this species is closely related to *A. speltoides*, another member of the Sitopsis group, the latter is looked upon as the donor of the B genome to the bread wheats) and yet some chromosomes do show close pairing as indicated by ring bivalent in F_1 hybrids mentioned above. In the derived amphidiploid several types of multivalents, such as, ring, zig-zag, figure of eight etc. are found. In spite of this, the fertility of this amphidiploid is as high as that of those plants where there is no multivalent at all. It is obvious from the configurations of the multivalents (microphotographs shown) that several of them cannot segregate regularly and would, therefore, give rise to unbalanced gametes. The normal fertility of this plant may, therefore, be due to compensation mechanism present in these species, as also reported between *T. aegilopoides* and *A. squarrosa* by Sears (1939). The chromosome pairing in the

F₁ hybrid further indicates that allelic genes on the chromosomes of the two species are present. This may be interpreted to mean that species of the two genera have evolved from a common stock and although the chromosomes in them have undergone modifications, yet there are segments which are similar. Secondly, it may also mean that there occurs frequently a flow of genes from one species to the other and thus absolute sexual barrier has not yet been established between them.

There is another group of hybrids and amphidiploids involving the diploid species *A. speltoides* and several species of tetraploid wheats. This group is particularly interesting because Stebbins (1959) and Riley *et al* (1958) have concluded that B genome of the tetraploid and hexaploid wheats has been donated by *A. speltoides* and not by *Agropyron* species as held by earlier workers. The F₁ hybrids in this group show very high degree of chromosome pairing indicating that the genome of *A. speltoides* is similar to one of the genome of tetraploid wheat. The derived amphidiploids are very unstable and show high frequency of multivalents. The different plants are quite dissimilar in their morphological characters indicating that because of irregular distribution of chromosome, gametes of different constitutions are formed. The main point of interest is that the F₁ and amphidiploid studies in this group clearly prove the close homology of a set of chromosomes of the tetraploid wheat with those of *A. speltoides*.

It may, therefore, be concluded that the genera *Triticum* and *Aegilops* are much more closely related than the other genera of the sub-tribe *Triticeanae*. In the revolutionary scale, these two genera appear to have separated much later than other genera of this order.

7. A. T. NATARAJAN (New Delhi) : *Polyploidy and Radiosensitivity.*

An understanding of the role of polyploidy on the radiosensitivity of cells has attracted the attention of many workers in view of its bearings in both fundamental and applied fields : (a) From agricultural point of view (in induction of beneficial mutations) it is of interest since many of the important crop plants like wheat, cotton and potatoes are of polyploid origin, (b) from medical point of view, in radiation therapy of cancer, it is of interest since malignant tumorous tissues comprise mostly of polyploid and aneuploid cells, (c) from radiobiological point of view it is of interest in understanding the resistance of certain adult tissues in comparison to young ones to radiation, which may be due in part to the highly polyploid nature of otherwise radiosensitive tissues, like liver tissues and (d) in understanding the mode of biological action of different types of radiations, since *polyploidy* is the only factor known to influence response to densely ionizing radiations.

The results obtained, in general, suggest that the radiation induced lethality decreases with an increase in ploidy. This is amply illustrated by *Sparrow* and co-workers, from their study of tolerance to chronic gamma irradiation of two polyploid series—Genus *Chrysanthemum* (Compositae, with $2n=18, 36, 72, 90$ and 198) and *Sedum* (Crassulaceae, with $2n=20, 28, 30, 34, 44, 48, 50, 54$ and 58). More detailed study of differential response between diploids and polyploids, including immediate growth response, somatic and gametic cytological changes as well as incidence of mutations in X₁ and X₂ generations has been made by *Swaminathan* and his associates in different types of polyploids like barley (diploid and colchicine induced tetraploid), wheat (diploid, tetraploid and hexaploid—different species and allied genera—of allopolyploid origin), cotton (diploid and tetraploid—an amphidiploid by origin) and *Sorghum* (diploid and tetraploid—the tetraploid having higher chromosome number ($2n=20$) with lesser total chromosome length and DNA con-

tent in comparison to diploids). While these studies supports the general theme of resistance of polyploids to radiation, interesting information with regard to the bearing of chromosome number, chromosome length, DNA content, the type of polyploidy, the interaction of genomes in allopolyploids as well as the impact of LET (linear energy transfer) towards the understanding of the role of polyploidy in relation to radiation response and how best radiations can be used to harness mutations with efficiency has been obtained. In yeast, in which detailed studies have been made with regard to survival following radiations, in haploid, diploid and polyploids confirm the higher resistance of polyploids, though the mechanism involved is not clear. The studies on *Habrobracon* (haploids and diploids) have shown that the degree of resistance of diploids in comparison to haploids varies according to the developmental stage in which the wasps are irradiated.

The general implications of the results obtained in these studies will be discussed.

8. G. PANIGRAHI and S. N. PATNAIK (Shillong) : *Polyplody in Polypodiaceae—Its Evolutionary and Adaptive Significance.*

The family Polypodiaceae represented by 21 genera and 106 species in India, occurs mostly as epiphytes on tree trunks or on humus-covered rock boulders in the tropical and subtropical evergreen forests although *Diplazis wallichii* as its only terrestrial Indian species, is restricted to Eastern India. An analysis of the cytological data available from 70 species belonging to 22 genera studied upto date shows that only 8 species are tetraploids whereas two others have attained hexaploidy only, all the remaining diploid species being characterised by a range of aneuploid base numbers varying between $x=11$ to $x=47$.

Thus, the low percentage (14%) and very low grade of euploidy in the predominantly tropical family Polypodiaceae are contrary to expectations. But the discovery of tetraploidy (viz. $n=66$) in the most primitive terrestrial species *Diplazis wallichii* and limitation of the evolutionary potential of euploidy to only species formation viz. in *Loxogramme*, *Pyrrosia*, *Lepisorus*, *Leptochilus* and *Polypodium*, have been utilised to suggest that epiphytic habit inside the closed evergreen forest canopy serves as a "bottle neck" to euploidy whereas terrestrial habit in identical situations may provide the necessary stimulus to the induction of euploidy.

Discovery of an astonishing array of haploid numbers in *Lepisorus* viz. $x=13$, 22, 23, 35, 36, 37 and 47 and of $x=36$ in 13 other genera postulated by contemporary taxonomists to have originated from *Lepisorus*-like ancestors on the basis of evidences from comparative morphology, establish *Lepisorus* as a highly potential "evolutionary plexus". The evolution of genera with $x=35$ and $x=37$ is explained by the aneuploid loss or gain of one pair of chromosomes. The formation of chains, variable number multivalents, bivalents and univalents in *Lepisorus pseudonudus* with $2n=39$ and the formation of 35 bivalents and one tetravalent or 35 bivalents and 4 univalents, or 36 bivalents and two univalents in different cells of *Drynaria quercifolia* with $n=37$ from Garo Hills, confirms the dominant role played by structural translocations in the origin of aneuploid base numbers in the family. The finding of so low base numbers as $x=11$ or 13 in *Lepisorus* point to the haploid numbers viz. $x=33$, 35, 36, 37, 47 etc. as tips of a divergent polyploid series. Thus, the aneuploid base numbers may be postulated to have acted as an "evolutionary pool" and thus, to have played the major role in the evolution and adaptation of the family Polypodiaceae to the peculiar "mid-air" habitats available to its members within the tropical and subtropical evergreen forests.

II. EVOLUTIONARY TRENDS IN GYMNASPERMS

Chairman : PROF. J. VENKATESWARLU, Waltair.

1. P. MAHESHWARI (Delhi) : *The Evolution of the Archegonium in Gymnosperms.*

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There is a considerable range of variation in the number of archegonia in gymnosperms. *Torreya taxifolia* and *Acropyle pancheri* have a single archegonium per ovule while in *Microcycas* and *Widdringtonia juniperoides* the number may go up to 200.

The families Taxodiaceae and Cupressaceae show a complex of archegonia surrounded by a common jacket. Such a condition also occurs sporadically in other gymnosperms and must be considered as more advanced than that of separate archegonia, each with its own jacket.

While the archegonia are normally apical, they are regularly of the lateral type in *Widdringtonia*, *Callitris*, *Sequoia* and certain other genera. Most of them develop around the terminal swollen part of the pollen tube which grows along the female gametophyte for a considerable distance. Archegonia in abnormal positions have also been seen in *Pinus*, *Cedrus* and *Ephedra*, and this is probably a derived condition. In the fossil gymnosperm archegonia have been observed only at the apical end and do not form a complex.

A definite ventral canal cell is seen only in *Ginkgo* and the Pinaceae; in the other gymnosperms only a ventral canal nucleus is seen. Even this may be absent in some Taxodiaceae and Taxaceae. There is thus a positive tendency towards the elimination of the ventral canal cell and the functioning of the central cell directly as the egg. Rarely, as in *Ephedra*, the ventral canal nucleus may also become fertilized but this bears no relation with the double fertilization in angiosperms.

The neck is four-celled in most genera but comprises 30-40 cells in *Ephedra* which merely illustrates that evolution may not take place at the same rate in all directions.

In *Welwitschia* and *Gnetum* there are no archegonia. In the former certain unspecialized cells in the upper part of the female gametophyte form the so-called embryo sac tubes. In *Gnetum* a few nuclei in the upper part of the gametophyte differentiate into egg cells under the stimulus of the pollen tube.

The gymnosperms show an approach to the angiosperms because of the reduction of the archegonium and its eventual disappearance but provide no clue to the origin of double fertilization. Unfortunately we have no knowledge of the reproductive structures of either the fossil gymnosperms or the fossil angiosperms.

2. K. R. SURANGE (Lucknow) : *"Evolution in Gymnosperms—Recent Fossil Evidences"*.

Various groups which have been assigned to Gymnosperms date back to the remote geologic past. Pteridosperms appear first in the lower Carboniferous, Cordaites and Conifers in the Upper Carboniferous and ginkgophytes in the Permian. Cycadales and Bennettitales are the Mesozoic groups.

What were the primitive Gymnosperms like? The Devonian is the age where we should look for primitive gymnosperms or the groups of forms from which gymnosperms must have arisen. Special attention is drawn to some of the Devonian genera about which we have known better in recent years. They are *Aneurophyton*, *Eospermatopteris*, *Protolittys*, *Pitys*, *Archaeopteris* and *Callixylon* etc. They are characterized by secondary growth and arborescent, or possibly shrubby habit, secondary tracheids with gymnospermous round bordered pits and compound or

branched leaf; but at the same time all were pteridophytic in reproduction. Are these the forms which were ancestral to gymnosperms? If it were so the existence of such plants of possible psilophytic origin, eliminates the necessity of considering any group of ferns as ancestors of the gymnosperms.

3 A. R. RAO (Lucknow) : *The Podocarpaceae in the Rajmahal Flora of India.*

I will confine my observations to just one group of gymnosperms namely the Coniferales and in that, the Podocarpaceae. The Podocarpaceae are regarded as an essentially Southern family and all the living members of this family are now confined mostly to the Southern hemisphere although a few species of *Podocarpus* cross the equator. The group is represented in a fossil state only from the Mesozoic onwards.

The Jurassic flora of India—particularly the Rajmahal flora is rich in conifer remains some of whose affinities are quite clear. The following are known to be definitely Podocarpaceous. Woods : *Mesembrioxylon* Spp. shoots : *Elatocladus jabalpurensis* Fst. *Elatocladus plana* (Est.) *Elatocladus conferta* (O & M) Halle, *Retinosporites indica* (O & M) Reproductive organs : *Strobilites Sewardi* (Sahni) *Stachytaxus* sp. *Nipaniostrobus Sahni* Rao, *Nipanioruha granthia* Rao, *Podosporites tripakshi* Rao and possibly *Masculostrobus rajmahalensis* Rao, *M. sahni* Mittre, *Pityosporites nipanica* and *Pityosporites* spp. These indicate the existence of a rich Podocarpaceous oelemet in the Indian Mesozoic flora. They further extend the vertical range of the group into the Jurassic age and show that the Podocarpaceae are indeed a southern family. Prof. Florin thinks that the conifer flora had become differentiated into two large phytogeographical dominions from the Permian onwards, and that the Podocarpaceae dominated the Southern conifer vegetation. The genera enumerated above strongly support to some extent Florin's theory. Florin also thinks that *Dacrydium* developed in the upper Mesozoic from some centre in East Australian or Antarctic region. *Nipaniostrobus Sahni* is most comparable to *Dacrydium*. *Acmopyle* is supposed to have developed from an origin centre in the Indo-Australian region to Antarctica and South Africa. *Retinosporites indica* according to Florin is perhaps an *Acmopyle*. *Phyllocladus Saxegothaea*, *Pherosphaera* and *Microcachrys* are also regarded as southern. The last three are not represented in a fossil state. Scattered pollen referred to above as *Podosporites tripakshi* can be compared to the pollen of *Pherosphaera* and *Microcachrys*. From the Jurassic of Australia Florin has described *Zamites (Podozamites) Barklyi* McCoyi Florin sp. nov., resembling a species of *Podocarpus* and *Elatocladus* sp. comparable to juvenile leaves of *Dacrydium intermedium*. From the Tertiary of Australia *Podocarpus precupressus*, *Dacrycarpus australensis*, *Dacrydium rhomboidium*, *D. araucarioides*, *D. cupressinum* and sporomorphs of *Dacrydium florini*, *Phyllocladus palaeogenicus* are also known. *Microcachrites antarcticus* is also probably Podocarpaceous. It thus appears that most of the Podocarpaceous fossils are from the Southern hemisphere. The present day distribution of the living Podocarpaceae is also confined mostly to the southern hemisphere, to only those lands that constituted the 'Gondwana land' at one time. This is rather significant and strongly suggests that this family really evolved in the Southern hemisphere, in Gondwana land.

The living Podocarpaceae show three main types of organization of the strobilus, (a) a compact cone, as in *Dacrydium* (b) a lax strobilus and (c) much reduced single seed-bearing receptacle as in *Podocarpus blumei*. The Rajmahal petrified strobili referred to above show that the compact cone and the lax strobilus were in evidence during the Jurassic period. We do not have enough data yet to definitely state that the reduced *Podocarpus blumei*-like single seeded receptacle was also present in the Indian Jurassic flora, although there are some suggestions to this effect.

4. T. N. KHOSHOO (Chandigarh) : *Cytological Evolution in Gymnosperms.*

Approximately 42% species of the gymnosperms have been studied cytologically. The investigated species cover about 82% genera, representing all the 13 living families. This leaves roughly 371 species and 13 genera (including the recently discovered Chinese genus *Cathaya*) totally unworked. A perusal of this data indicates that the major cytogenetic processes of evolution in the group are the karyotypic alterations, gene mutations and hybridization. Polyploidy is very low in incidence, being totally absent in Cycadales and Ginkgoales. Clear cut cases of agamospermy are also unknown in the group.

This paper gives a short account of the genetic system of a typical gymnosperm, trends in karyotypic evolution, probable causes for rarity of polyploidy and apomixis in the group, and, lastly, the scope and limitations of the cytological and cytogenetical studies in the understanding of interrelationships within the gymnosperms.

5. D. C. BHARADWAJ (Lucknow) : *Pollen grains of Ephedra and Welwitschia and their Probable Fossil Relatives.*

The pollen grains of *Ephedra foliata* Boiss., are pointedly oval with a number of contiguous ridges extending longitudinally from the two ends. The vertex of the ridges is well defined and wavy whereas the groove or colpus in between the ridges is straight but faintly apparent. A t.s. of the nearly mature grains is \pm circular with 14-18 teeth-like projections (the ridges) each with an acute apex and a broad base immediately below which is a thin glistening layer of exine followed by a darker lining layer. In fully matured grains the ridges develop a cavity inside, due to the separation of ectexine along the glistening layer. In immature grains the ridges are rounded without a defined crest and the grooves at the base of the furrow are prominent. In general, the pollen morphology for most of the other species of *Ephedra* agrees to that of *E. foliata*.

In early history, dispersed, fossil pollen grains comparable to those of *Ephedra* are shown to occur in strata extending to Permian.

The pollen grains of *Welwitschia mirabilis* Hook., are pointedly oval with a single deeply concave invagination running longitudinally. In a t.s. through the middle they appear horse-shoe shaped. The surface of the exine in mature grains bears a number of longitudinally running, low and rounded ridges with narrow, sharply defined grooves in between them. In immature grains, minute, closely spaced grooves and ridges running transversely over the exine and the slight separation of ectexine from intexine at the pointed ends, not traceable in mature grains have been observed.

In the geological past, monocolpate fossil pollen grains organisationally comparable to such of *Welwitschia* have been known from Bennettitales, Cycadales and Pentoxyleae of the Mesozoic and the modern *Ginkgo*. In addition to these a number of dispersed, fossil pollen grain genera are reported from strata extending to Permian which show fairly close similarity with the pollen grains of *Welwitschia*.

It has been concluded that morphographically the pollen grains of *Ephedra* and *Welwitschia* substantially differ from each other and that the pollen morphology of *Welwitschia* brings Welwitschiales still closer to Bennettitales with which it is already known to correspond in respect of stomatal apparatus, ovule and seed structures as well as floral morphology.

6. VISHNU MITTRE (Lucknow) : *The Ice Ages and the Evolutionary History of the Indian Gymnosperms.*

The glacial epochs are instrumental in numerous ways in creating circumstances directly affecting the evolution of new taxa and in changing the pattern

of vegetation. The repeated manifestations of the climatic changes, the creation of land bridges and the land barriers in the past have governed the immigration of the plant species and the shifts in the vegetational belts both latitudinally and altitudinally. The diastrophic events have further helped processing the evolutionary trends.

In the background of the successive climatic and physiographic changes during the Pre-Pleistocene and Pleistocene Ice ages, an outline of the evolutionary history of the Indian Gymnosperms is presented.

The long period of time between the Permocarboniferous glaciation and the onset of the Pleistocene Ice age has witnessed the origin and the immigration of gymnosperms and their luxuriant growth during the period of increasing warmth, and their gradual diminution and virtual extinction during the period of climatic optimum (Eocene). The progressive deterioration of climate during the late Tertiary period (Miocene and Pliocene) helped the gradual immigration of the modern conifers which established themselves during the Pleistocene Ice age. Whereas the climate had been largely responsible for their immigration and spread until towards the beginning of the Postglacial period, thereafter the coniferous vegetation has also been partly affected by the anthropogenous influence by clearance of forests and by plantation of both the indigenous and the exotic spp.

The successive changes of climate and physiography during the Pleistocene period resulted in the disjunct distribution of the once widely and continuously spread plant species and since that time the species isolated have been struggling hard against the new and the changing environments. It is amongst these that the new evolutionary trends may be recognised manifested in the physiological and ecological races—the ecospecies—which constitute the potentials of the future gymnosperms of India.

7. C. G. K. RAMANUJAM (Hyderabad) : *Xylotomy of the Gymnosperms.*

The present paper deals with the structural specialization of the xylotomy (primary and secondary wood) of the four large groups of gymnosperms viz., pteridospermophyta, cycadophyta, coniferophyta and chlamydespermophyta.

Xylotomical features cannot be taken by themselves, as infallible criteria in the identification, classification and phylogeny of the diverse orders of the gymnosperms.

Xylotomically the pteridosperms show little or no relationship with the cordaitales, their palaeozoic contemporaries. The early cessation of the activity of the cambium as evidenced by the pteridosperm stems probably represents a primaevial state of affairs among the gymnosperms. The xylotomy of the pteridospermophyta is very much unspecialized; the tracheids are very long and broad and show copious reticulate-bordered pitting which, paligenetically represents the primitive type of pitting for this group. The xylem rays are very high, broad and heterogeneous, with the ray cells primitively thin-walled, smooth and unpitted.

The wood of cycadophyta is, as a rule, manoxylic with a broad zone of transition between the protoxylem and the secondary tracheids. Radial pitting is largely scalariform in cycadeoidales and circular bordered in cycadales. Xylem rays are homogeneous, narrow or moderately broad, with all the walls thin, smooth and unpitted.

Xylotomically the cordaitales, ginkgoales and coniferales constitute a well-knit and closely interrelated group. The wood of the coniferophyta is characteristically pycnoxylic. With the exception of cordaitales the primary wood of the rest, is highly specialized. No scalariform pitting is found in the wood. Radial pitting is broadly of two types viz., cordaite-araucarian and abietinean; the former is geologically the older of the two. The evolutionary specialization of the xylem

parenchyma, ray sand the resin ducts, has been broadly discussed. There seems to be no definite correlation between the xylem parenchyma and the appearance of seasonal growth.

Xylotomy of the gnetales is of a very advanced type among the gymnosperms. Xylotomically the genera *Ephedra*, *Gnetum* and *Welwitschia* are more closely interrelated than any one of them is related to any other gymnosperm.

Fossils of the upper Cretaceous and lower Tertiary periods indicate that there has been no appreciable change in the structural specialization of the xylotomy of gymnosperms during the last 60—80 million years.

III. PARASITISM AND SYMBIOSIS

Chairman : PROF. J. VENKATESWARLU, Waltair.

1. T. S. SADASIVAN (Madras) : *Opening remarks—General.*

Parasitism in a broad sense is ascribable to any agent capable of interfering with the life processes of a host, be it of microbial origin, or one of the angiosperms themselves. Generally, the more vigorous and destructive a parasite, the less its chances of survival, and conversely, the more tolerant the host to a parasite, the more chronic the disease and greater are the chances of survival of the parasite. The story of breeding wheat for resistance to *Puccinia graminis* in the U.S.A. clearly indicates what a checkered history it has had with every new race and biotype of the rust fungus that nature put up to match the ingenuity of the breeding programme for evolving resistant wheat varieties. The control of parasitism in fungi is complex as there is no proved defence reaction in plant tissue akin to antibody formation in animals. Nevertheless, the recent report of the formation of what appears to be an antibody in orchid bulbs, in the form of a substance called orchinol, consequent on infection of tissues, is a major break through in this fascinating field of host-parasite relationship *in vivo*.

The barrier to infection by plants resistant to fungal obligate parasites with external mycelia seems to be susceptibility of host cell cytoplasm to fungal metabolites and in extreme cases of obligate parasitism like in *Plasmodiophora brassicae* this association is within the host cytoplasm itself. Types of barriers in plants that affect parasitism are to be mentioned and discussed.

Symbiosis, on the other hand, is as complex as parasitism and defies being explained in any simple manner. While lichens and nodule bacteria represent ideal examples typifying commensalism, in recent years, the role of algae in such commensal association with the angiospermous plant has come into limelight. They are now known to liberate extracellular metabolic products having ecological importance in soils. Their capacity to fix atmospheric nitrogen seems beyond doubt and, therefore, their association in roots of *Cycas* and orchids may throw new light on the phenomenon of symbiosis.

2. C. V. SUBRAMANIAN (Jodhpur) : *General aspects of symbiosis.*

Symbiotic associations between microorganisms and other microorganisms or plants or animals are as varied as they are widespread. These include associations of algae with fungi to form lichens, of algae (*Zoochlorella*, *Zooxanthella*) with freshwater and marine animals; of fungi with plant roots to form mycorrhiza, of yeasts and yeast-like fungi in the rumen of sheep and other animals and also associated with wood-feeding and plant-sap-sucking insects, of *Septobasidium* spp. with scale insects, of fungi and ambrosia beetles; of bacteria (*Rhizobium* spp.) with roots of legumes to form nodules, and of bacteria forming an essential

intestinal microflora in many insects and animals. A brief survey of our present knowledge of the physiology of these relationships is presented, aimed at an elucidation of the nature of the relationship in each case, as far as is known. From what we know of these, it appears that the ability of two ((in a few cases more) partners to live together in stable balance without destroying the other or being destroyed is the essence of symbiosis. There is almost always mutual benefit for the partners, but the extent to which each partner benefits *vis-a-vis* the other varies. Elucidation of symbiotic relationships in the past has largely been guided by studies of the behaviour of the symbionts separately (*in vitro* if symbiont is a microorganism) with a view to ascertain their inherent individual nutritional and other requirements. These studies have often revealed heterotrophy for one or both partners. Speculations on the origin of heterotrophy and indeed of the symbiotic association itself have been made in the past and are interesting, but speculations will have to be built on critical and intensive study of the symbionts not only separately as has been done in the past but also in association with each other as they are seen in nature.

3. Miss L. SARASWATHI-DEVI (Madras) : *General aspects of parasitism.*

Parasitism is, by definition, living at another's expense and, hence, an *attack* by one organism on another, and is essentially dualistic and antagonistic. In other words, a parasitic organism meets its primary requirements of nutrition by encroaching on another living organism. This association being thus essentially a nutritive one, it is seldom that the attacked host is left uninjured, and this has led to the rather indiscriminate usage of the terms "parasitism" and "pathogenicity". The two are not synonyms and certainly pathogenicity is not the ultimate aim of a parasite. Practically, however, it is almost impossible, at least as far as plant parasites are concerned, to draw line between parasitism and pathogenicity. By far the majority of instances involve a microorganism parasitizing a more highly evolved organism.

Parasites may be necrotrophic (destructive) or biotrophic (balanced). The former are usually strong producers of exocellular metabolites such as enzymes and toxins which destroy the host tissue, whereas the biotrophic parasites, of necessity, do as little damage to the host as possible so as not to jeopardize their own development, at least till the fruiting stage. The smuts are excellent examples of such balanced parasites.

From the primitive type of necrotrophic parasite we have different gradations all the way up to the obligate and highly specialized balanced parasitism, of which the conventional symbiosis, such as that of mycorrhiza, is but the ideal condition. The degree of host damage and of specialization and specificity in parasitism is governed by many factors including the innate nature of the parasite, its nutritional requirements, the nature and type of resistance it has to encounter in the host.

Parasitism, *i.e.*, the ability to attack and grow in living tissue, is definitely a positive capacity, in the evolution of which, however, the organism had to forego other properties, and this leads one to the philosophical conclusion that nothing is gained without giving, and that specialization involves a good amount of sacrifice.

4. B. TIAGI (Jodhpur) : *Abnormal growth and parasitism.*

Parasitism by microorganisms leads to disease in plants. Besides the usual symptoms, the host tissues may show abnormal growth forming galls, tumours and witches' brooms. There may also be associated some secondary effects on the host resulting in the transformation of floral organs into curious structures.

Agencies causing abnormal growths in plants are : insects, nematodes, fungi, bacteria, viruses and non-parasitic factors.

An attempt has been made to review the literature on the subject and the work which is being done in this laboratory on the following : *Physoderma*, *Synchytrium*, *Protomyces*, *Protomyopsis*, *Uromyces*, Rusts, *Albugo*, *Taphrina*, and *Sorodiscus*.

Galls are classified variously; depending upon the agency making the gall, pattern of development, morphology and histology.

Braun recognises two types of abnormal growths.. Self-limiting having a definite pattern of development and non-self-limiting tumours possessing transplantable cells, proliferating randomly. Tumour cells acquire autonomy, the nature of which may lead to an understanding of similar cancerous growths in men and animals. Crown galls caused by *Agrobacterium* are of this nature. Self-limiting galls include insect, virus and fungal galls, bacterial root nodules and nematode root knots.

Butler and Jones classify abnormal growths as Histoid and Organoid. The former are due to a local stimulant action. Organoid galls result from systemic infection, inducing changes in habit and symmetry.

Gaumann recognises four types of abnormal growths : galls, tumours, witches' brooms and activation of rudimentary sexual organs. The morphogenic stimulus affects a cell or parts of tissues in forming galls and tumours and the whole buds in witches' brooms.

Following are critically reviewed : (1) Fungi—*Plasmodiophora*, *Synchytrium*, *Physoderma*, *Albugo*, *Peronospora*, *Peridermium*, *Nectria*, *Sphaeropsis*, *Taphrina*, *Exobasidium*, *Haplophragmiopsis*, *Uromyces*, *Uromycladium*, *Gymnosporangium*, *Ustilago*, *Tilletia*, *Urocystis*, *Melanopsichium*, *Melanotaenium*, and *Pericladium*. (2) *Agrobacterium tumefaciens* and Virus malformations.

Profound secondary effects are produced by the following : *Albugo*, *Peronospora*, *Sclerospora*, *Taphrina*, Rusts and smuts.

5. H. S. NARAYANA (Jodhpur) : Morphology and anatomy of nodules.

The nitrogen fixing bacterial nodules are present on the roots of legumes and certain non-legumes besides a report on stem of a legume.

The two types of nodules (effective and ineffective) on the basis of nitrogen fixation are distinguishable externally by the size and colour and internally by the meagre or total absence of bacteriod area and high percentage of disintegrating tissue. In contrast to the general conception, the effective nodules may be present even on the tertiary and quarternary roots as observed by the author in *Dolichos biflorus*, *Cymopsis tetragonoloba*, *Vigna catjang*, besides on the primary and secondary roots. They are either endogenous or exogenous in origin.

The effective nodule consists of the central bacteriod region, outer nodule cortex supplied by the vascular strands and distal meristematic zone. There may be a general endodermis outside the nodule cortex or individual endodermis around each vascular bundle. The presence or absence of meristematic zone cannot be correlated with endogenous or exogenous origin of nodule : The vascular bundles that supply the nodule exhibit variation in number and orientation in nodules of different hosts, nodules of the same host and even in the same nodule at different heights. The variation in the percentage of infected to the uninfected cells is also met with.

The mode of infection is predominantly through the root hairs, although infection through ruptured cortical cells in the vicinity of lateral root and the epidermis is known.

The nodules in the perennials are long-lived and in some bear rootlets developed within the endodermis of the vascular strands. The author will present his own observations and discuss the aforementioned points.

6. N. RAJAGOPALAN (Madras) : *Physiology of nodule function.*

The basis of effectiveness in root nodule symbiosis seems to depend on a biochemical compatibility between the host plant and *Rhizobia*. A possibly fundamental role may be played by chlorophyll synthesis in the leaves in apportioning levels of adaptation such as effectiveness, ineffectiveness and parasitism, since nodules are not formed in root cultures. One at least, of the biochemical host properties which confer effectivity, is the synthesis of haemoglobin in "effective" root nodules. This haemoprotein is formed as a result of a specific interaction between a compatible bacterial strain and the proliferating host tissue. Pertinence here attaches to a positive correlation between haemoglobin content and the intensity of nitrogen fixation.

Factors governing the formation and function of this metalloporphyrin protein in the root nodules remain at present largely obscure, although glycine has been shown to be a specific precursor for its formation. Interest centres on this fact since glycine is also a specific precursor for chlorophyll synthesis. Construed in this light, the formation of haemoglobin and a control of its quantitative levels in nodules through levels of illumination of the host plant are suggestive of foliar influence. Such influence in a hypothetical sense may depend on the synthesis of porphyrin precursors or amino acids in leaves.

Thus, the protein metabolism of nodules may have to be integrated with the metabolic induction of specific substrates in leaves. The significance of these factors in the light of work carried out in this laboratory will be discussed.

7. R. S. BADAMI (Madras) : *Viruses and parasitism.*

Virus host physiology in terms of disturbances in the protein metabolism of the host have taken several avenues of expression. And obligate parasitism which is an intrinsic property of viruses ranges from strict pathogenicity to a balanced commensalism with reference to the host plant. Relatedly, work on the morphological structure of virus particles has led to a measure of agreement on their properties of infectivity and serological specificity.

Emphasis however is placed on the physiological condition of the host plant since it conditions to a large extent the ability of a virus to infect, multiply and cause symptoms. This naturally leads on to the subject of transmission of virus diseases from one host to another. And apart from normal modes of transmission through the soil and mechanical means, viruses are also carried through aphids, leaf-hoppers and also multiply in them. The specificity of virus-vector relationships have become so complex that nothing short of inroads into insect physiology can explain them. Another degree of relation is the pathogenic nature of viruses to transmitting insects as well as to susceptible plants. Specific instances are known of Polyhedral and other virus diseases proving lethal to insect pests (pine saw-fly). Application of this in biological control of injurious insects is yet in its infancy.

These aspects with regard to the role of diverse factors and the physiological state of the host plant in relation to Tobacco mosaic virus and Dolichos enation mosaic virus and also biological partnership of host plant in relation to Cucumber mosaic virus and Potato virus will be presented.

8. N. S. SUBBA RAO (Madras) : *"Ectotrophic fungal associations with roots"*.

The surface of roots with the attendant microflora is often referred to as the rhizoplane. It constitutes the innermost stratum of the rhizosphere, the zone of interaction between plant roots and soil microorganisms. A specialized case of fungal association in the rhizoplane has resulted in the origin of ectotrophic mycorrhiza where the bulk of the mycelium forms an external mantle around the roots with the intercellular Hartig's net acting as the liaison-tissue between the two symbionts. The ectendotrophic mycorrhiza represent a case of root-fungus association where the hyphae of the intercellular Hartig's net occasionally penetrate the cell-lumina of the higher symbiont. Intracellular penetration of the fungal hyphae into the luminae of the root cells followed by the digestion of the hyphae is a rule in endotrophic mycorrhiza. These transitional series of associations may be viewed as a probable line of evolution from the rhizoplane habit. Experimental evidence relating to the two-way biological relationship between the symbionts such as the part played by the fungus in salt absorption, the liberation of vitamins by the roots and their utilization by the fungus together with the role of the fungus in the morphogenesis of the root system of some trees will be surveyed. While much attention has been paid to the associative and antagonistic effects of microorganisms of the root region, relatively little is known concerning the part played by them in the well-being of the plant; an attempt has been made in this direction by the author and the results obtained will be discussed.

Section of Medical and Veterinary Sciences

Chairman : DR. J. C. BANERJEA, Calcutta.

1. J. C. BANERJEA and J. C. BAL : *Studies on Hepatic Cirrhosis.*

Cirrhosis of liver in our country was so long regarded as mainly due to nutritional deficiency. Recently Gillman and Gillman have shown that cirrhosis of liver does not follow the nutritional deficiency in kwashiorkor. With a view to ascertain the aetiology of cirrhosis of liver in our country, 36 cases showing hepatosplenomegaly with or without jaundice and ascites were investigated clinically and histological examination of liver biopsy specimen was made in 29 of them. Relevant biochemical examinations and radiological study by means of splenic venography and barium swallow of the oesophagus were made.

Results of investigations revealed that a previous history of viral hepatitis could be obtained in 36% of cases. A histological diagnosis of post hepatitis cirrhosis of liver could be obtained in 21 cases, which could be correlated with the clinical, biochemical and radiological findings. 4 cases where liver biopsy was not corroborative were presumed to be of viral aetiology from clinical and biochemical evidences. Three cases were in all probability cases of portal cirrhosis. Five cases were likely to be cases of primary portal hypertension syndrome. One case showed cardiac cirrhosis and remaining 2 cases did not show evidences of cirrhosis.

Thus 34 cases of the series presented cirrhotic changes in the liver, out of which 25 cases (73.5%) were cirrhosis of viral origin. The incidence of portal cirrhosis was definitely insignificant in this series.

2. G. S. MAHAPATRA (Cuttack) : *Hepatic cirrhosis and ascites.*

A total of 88 cases of Ascites has been studied from various angles. In all these cases detailed history and clinical findings were obtained with special reference to social status, dietetic habits, addiction habits, history of attack of Jaundice and history of Gastro-Intestinal bleeding episodes. The ascitic patients were divided into four groups :—

Degree I Ascites—Marked abdominal protuberance. Shifting dullness +. No fluid thrill. Abdomen skin loose.

Degree II Ascites—Moderate protuberance of abdomen. Shifting dullness ++, no fluid thrill. Abdominal skin slightly tense. No prominent superficial veins.

Degree III Ascites—Marked abdominal protuberance. Shifting dullness ++, fluid thrill ++. Abdominal skin tense slightly prominent superficial veins. Eversion of umbilicus.

Degree IV Ascites—Very marked protuberance. Shifting dullness +++, fluid thrill +++. Superficial veins prominent. Marked eversion of umbilicus.

In all these cases the following investigations were carried out :

1. Liver function tests.
2. Liver Biopsy.
3. Radiological Examination.
4. Ascitic fluid examination.

Of the 88 cases studied, only 48 cases were diagnosed clinically as cirrhosis of liver. Liver Biopsy was attempted in 31 patients of this group, of which three were unsuccessful even on second attempt probably because the liver was too shrunken and hard. In rest of the 28 cases biopsy revealed normal liver pattern in six cases, diffuse hepatic fibrosis in 15 cases, post necrotic cirrhosis in three cases and early fibrosis with marked changes in four cases.

The grading of hepatic fibrosis was carried out according to histological criteria described by Mangalik et al. All cases with normal liver pattern and most cases with early hepatic fibrosis had lesser degree of Ascites (I & II degree). Among those with diffuse hepatic fibrosis there was seen a fairly direct relationship between the amount of fibrosis in the liver and the degree of Ascites. The greater the hepatic fibrosis the greater was the amount of fluid in the peritoneal cavity.

3. J. C. BANERJEA : *Evaluation of modern oral diuretics.*

Some of the modern oral diuretics such as Benzthiazide (Fovane); Bendroflumazide (Aprinox, Neonaclex), Hydroflumethiazide (Naclex), Hydrochlorothiazide (Esidrex) were tried by turn in four groups of oedematous patient viz., Cardiac, Cirrhotic, Nephrotic and Nutritional for a period of four days each, interposed with a period of four days during which no diuretic was used. Before starting a diuretic, the patient was kept at bed rest on a standardised diet containing about 3 G of Na (Sodium). Fluid intake was not restricted, and average of the total urine output in 24 hours for four days was estimated. The diuretic response was considered good if the average output during the 4 days' period of diuretic therapy was increased by 100% or more above the average basal output; fair, if, increase of 50% to below 100% and poor if response is below 50%. Serum sodium and Potassium estimations were made in 8 cases before and the end of the diuretic therapy. No significant alterations were observed.

Irrespective of the type of oedema, diuretic response was best with Benzthiazide and next in order of efficacy were Bendroflumazide, Hydroflumethiazide, Hydrochlorothiazide.

In cirrotic oedema Benzthiazide and Hydroflumethiazide both were of equal efficacy with a good response. Next in order of merit were Hydrochlorothiazide and Bendrofluazide of equal efficacy.

In Cardiac oedema Hydroflumethiazide appeared to give the best diuretic response; next in order of efficacy were Benzthiazide, Bendrofluazide and Hydrochlorothiazide.

In Nephrotic oedema Benzthiazide appeared to give the best diuretic response. Hydrochlorothiazide, Bendrofluazide both appeared to give the next best diuretic response. Hydrochlorothiazide was next in order of efficacy.

Benzthiazide and Bendrofluazide both appeared to give same diuretic response in Nutritional group of oedema cases. Next in order of efficacy were Hydrochlorothiazide and Hydroflumethiazide.

4. J. B. CHATTERJEA (Calcutta) : *Chronic haemolytic anaemias—Aetiopathogenetic aspects.*

In chronic haemolytic anaemias, erythrocytic life span is always shortened so that more red cells are destroyed than can be formed by the compensatory bone marrow activity. The excessive haemolysis beyond physiological limits may be predisposed by an intrinsic intra-erythrocytic defect or is brought about by extra-erythrocytic haemolytic factors. The intra-erythrocytic defects represent hereditary disorders and include the following :

(a) *Haemoglobinopathic syndromes* viz., Homozygous thalassaemia; Homozygous states for various abnormal haemoglobins (S.C.D.E.); Double heterozygote states (Hb. F-thalassaemia, Hb. S-thalassaemia) and other related disorders. The main anomaly is in the sequence of aminoacids that form the polypeptide chains.

(b) *Haemolytic reactions* following exposure to certain agents, viz., primaquin and fava beans. These affect only those subjects who exhibit a deficiency of erythrocytic enzyme, glucose-6-phosphate dehydrogenase.

(c) *Hereditary spherocytosis* and related disorders. The extraerythrocytic haemolytic factors are exemplified by infections, immunologic disturbance due to isoimmunisation or auto-immunisation and hypersplenism.

Haemoglobinopathic disorders constitute a significant problem in India. In West Bengal 7.6% of general population has been shown to possess haemoglobinopathic trait of some form or other. Approximately 5% of Indian population shows deficiency of erythrocyte glucose-6-phosphate dehydrogenase activity of red cells. In India incidence of hereditary spherocytosis is much lower than that of haemoglobinopathy or enzyme deficiency.

5. RATHINDRA NATH RAY (Calcutta) : *Diagnosis of Chronic haemolytic anaemias.*

Chronic haemolytic anaemias may be due to intracorpuseular or extracorpuseular defects. Disorders like haemoglobinopathy, hereditary spherocytosis and auto-immune acquired haemolytic anaemia will be discussed.

The diagnosis depends on thorough clinical and laboratory investigations. In the clinical study, evaluation of age, sex, duration of illness, degree of anaemia and jaundice, facies, enlargement of spleen and liver should be properly done to get some idea about the type of disorder.

In the laboratory investigations, various haematological data both in the peripheral blood and in the bone marrow provide useful informations. The presence of osmotically fragile red cells in hypotonic saline solution along with positive Coombs test indicates auto-immune haemolytic anaemia, whereas in hereditary spherocytosis

though the red cells are fragile but the Coombs test is negative. Electrophoresis of haemoglobin is a useful procedure for proper characterisation of haemoglobinopathic syndrome. Radiological changes in bones in congenital haemolytic anaemias and changes in stool and urine due to hyperhaemolysis give corroborative evidences in favour of chronic haemolytic anaemia.

Last but not the least, thorough clinical and haematological investigations of the family members including the parents is important to confirm the diagnosis of congenital haemolytic anaemias.

6. SHARAD KUMAR : *Mechanism of haemolytic anaemia.*

The administration of haemolytic sera to experimental animals for the production of a condition analogous to acquired haemolytic anaemia in humans is a relatively recent procedure. Although reference to such work dates back to Hayem (1898), the first significant observations on the role of haemolysins as the cause of clinical and experimental haemolytic anaemia were made by Dameshek and Schwartz (1938). Since then immune sera against the various formed elements of blood have been extensively employed, not only in the study of the mechanism of haemolytic anaemias (Wasastjerna, 1948; Young et al, 1949; Kumar, 1956), but also in the study of purpuras (Bedson, 1921; Witts, 1955) and agranulocytosis (Moeschlin, 1954) experimentally. The present study was undertaken to produce haemolytic anaemia experimentally with a view to investigate the mechanism of its development and to determine the role of spleen in its genesis.

It was observed that the resulting anaemia was acute or chronic depending upon whether the route of administration was intra-cardiac, intraperitoneal or intramuscular. Chronic anaemia developed only in 3 out of 10 guineapigs treated intramuscularly. The development of anaemia took place in three phases. The first phase was concerned with the formation of spherocytes and characterized by progressive decrease in the mean corpuscular diameter, by an increase in mean corpuscular thickness and parallel increase in the osmotic fragility of red cells. This was followed by the second phase in which progressive anaemia developed. The third phase was characterized by marked regenerative activity of the bone marrow. Removal of spleen appeared to protect the animal against the influence of the antiserum as judged by the development and recovery from anaemia, the lethal effect of the antiserum and the formation of spherocytes.

I. STUDIES ON HEPATIC CIRRHOSIS DISCUSSION

The Chairman in introducing the subject drew attention of the audience to its importance and the complicated nature of its aetiology. He requested the members to present their views based on personal experiences.

Dr. G. S. Mahapatra (Cuttack)—From a study of 88 cases of ascites he observed that 48 cases were due to cirrhosis of the liver. He stressed on infective hepatitis as the cause of cirrhosis.

Dr. P. N. Sahu (Cuttack) discussed the role of alcohol, deficiency of the various lipotropic factors such as choline, methionine, etc., and of infective hepatitis in the pathogenesis of hepatic cirrhosis.

Dr. A. M. Tripathy (Professor of Pathology, Medical College, Cuttack) described the invariable occurrence of extensive ulceration of the intestines in cases of hepatic cirrhosis and discussed at length on the role of endocrines in the pathogenesis of cirrhosis.

Dr. P. C. Sen Gupta (Calcutta) spoke on the various environmental factors and thought that the role of malaria and amoebiasis in the causation of cirrhosis should be considered.

Dr. Sujata Chowdhury (Calcutta) stressed on the importance of malnutrition and chronic enteritis in the causation of cirrhosis and of the gamma globulin as a protective factor.

Dr. Pande spoke on the value of immuno-electrophoresis in the diagnosis of cirrhosis of the liver.

Dr. V. K. Nanda thought that cirrhosis was the result of some blocking of the hepatic tissues. He stressed on the importance of biopsy in the diagnosis of cirrhosis.

Shri H. N. Das (Bhubaneswar) spoke of hepatic cirrhosis occurring in animals due to liver fluke infections.

Shri C. Seetharaman spoke of an infective hepatitis occurring in ducks and pointed out that it may be the probable cause of cirrhosis.

In summary the Chairman emphasised that from his studies in collaboration with his colleague Dr. J. C. Bal it appeared that infective viral hepatitis was the most important cause of hepatic cirrhosis, at least in the State of West Bengal. Portal cirrhosis (Laennec's type) was rare. Nutritional deficiency played an insignificant role.

II. NEWER ORAL DIURETICS : THEIR ACTIONS AND USES

Chairman : DR. J. C. BANERJEA, Calcutta.

Dr. B. B. Roy (Calcutta) in his introductory remarks spoke on the basic mechanism of urine secretion and how it was influenced by the newer oral diuretics of the thiazide group as compared to the mercurial diuretics. The basic mechanism of the secretion of urine was more related to the role of enzymes on the function of the renal tubulas than of the glomeruli. The diuretic agents modified the enzymatic action. He discussed the drawbacks of these diuretics which caused ionic imbalance. In conclusion he pointed out the value of these newer diuretics of the thiazide group as prophylactic agents against nocturnal cordiae dyspnoea.

Dr. Ojha (Cuttack) dealt with the pharmacological aspects. Besides enzymes, neurochemical and metabolic products were also essential for diuresis. Calcium used intravenously acted as a good diuretic agent.

Dr. B. Tripathi (Cuttack) listed the various newer oral diuretics and enumerated their uses in conditions with or without oedema. From clinical trials (78 observations in 48 patients) with hydrochlorothiazide he concluded that it was most effective as a diuretic agent in hepatic oedema, moderately effective in nutritional and nephritic oedema, and less effective in cardiac and nephrotic oedema. The efficacy was assessed on the basis of decrease in body weight from the pre-treatment level and increase in urine output over the pre-treatment average output. He pointed out that digitalis in cardiac oedema and prednisolone in hepatic oedema augmented the effect of the diuretic agent. In hepatic and cardiac cases hydrochlorothiazide was found to be superior to chlorothiazide or to neptal injections. It also potentiated the anti-hypertensive action of pentolinium tartarate (ansolysen) and apresoline.

Dr. G. S. Mahapatra pointed out the toxic effects of diamox such as enteritis, frequent micturition and sudden death.

Dr. J. C. Banerjea, Chairman, high-lighted the points of discussion and confined his remarks to the thiazide group of diuretics only. In his experience hydrochlorothiazide did not prove to be superior to mercurial diuretics in the management of cardiac or hepatic oedema. He advocated the intermittent use of the

thiazide group of diuretics to avoid hypopotassemia. Hence the combination of an antihypertensive drug such as reserpine with hydrochlorothiazide for daily use was not desirable. From observations in a limited clinical trial with three oral diuretics, viz. hydrochlorothiazide, hydroflumethiazide and benzthiazide. Dr. Banerjee found that in cardiac oedema all the three diuretics were equally effective provided adequate digitalisation was maintained. Benzthiazide was the most effective diuretic in nutritional and nephrotic oedema, whereas hydroflumethiazide proved superior to the other two diuretic agents in the management of cirrhotic oedema. He stressed, however, on the necessity of further extensive clinical trials for a proper evaluation of the newer oral diuretics.

I. MAXIMISATION OF AGRICULTURAL PRODUCTION

Section of Agricultural Sciences

Chairman : PROF. P. K. SEN, Calcutta.

1. Dr. J. N. Mukherjee (Calcutta) opened the discussion and particularly emphasised the importance of introducing crop rotation in our agricultural practices.

2. DR. B. N. SAHU (Bhubaneswar) : *Maximisation of Agricultural Production.*

The basic objective of India's development is to provide the masses of Indian people the opportunity to lead a good life. This is possible only by increasing production level than at present. So in the scheme of development the first priority has been given to Agriculture. The agricultural production has to be increased to the highest level feasible. A target has been fixed to increase the production of food grains and other agricultural commodities by 32 and 30 per cent respectively by the end of the Third Five Year Plan.

The principal technical programme for increasing agricultural production around which intensive work has to be organised, as laid down in the Third Five Year Plan are (1) irrigation, (2) soil conservation, dry farming and land reclamation, (3) supply of manures and fertilisers, (4) seed multiplication and distribution, (5) better agricultural implements, (6) adoption of improved agricultural practices and (7) plant protection.

Top crop begins with best seed.

Yielding ability of a crop is an inherited character and differs among varieties. Pure seed outyields commercial and non-certified seeds. It eliminates immature, partially filled and shrivelled seeds and thereby ensures higher percentage of germination. Absence of varietal mixture produces more uniform plant height and maturity minimising harvest loss. Absence of weed seeds minimises competition for space, light and nutrition. It is for this the Food and Agricultural Organisation (F.A.O.) of the United Nations has declared the year 1961 to be the World Seeding Year under its campaign for Freedom from Hunger. In Federal Republic of Germany, good seeding, gets the farmer a one hundred fold return. There are model farms which for 60 kilos of seeding rye per hectare, are able to harvest no less than up to 6,000 kilos. Improved seed must be made available to the cultivators in time and close to their door. There should be a seed store to cater to the needs of every 20 villages. Establishment of seed corporation will help production of nucleus seed, maintaining purity and maximum yield. Legislation

for controlling quality of seeds and regulating their production, marketing and movement should be enacted

Fertiliser is a single factor which can produce high yields and that too in short time. In Western Europe, Japan, Canada and U.S.A. 25 to 50% of total agricultural production can be attributed to regular use of fertilisers. In India, the soil does not get sufficient plant food in return for what it gives in feeding growing crops. Most fertile soils cannot continue to supply all nutrients removed indefinitely. So to meet the nutrient requirement of crops it is essential to provide adequate supply of the nutrients by addition of manures and fertilisers. Recommendations of the Fertiliser Distribution Enquiry Committee regarding use of fertilisers in the form of mixtures with a view to promoting balanced fertilisation, improved arrangements for distribution and reduction in cost of distribution should be taken up. The U.N. Fertiliser Mission have recommended for extensive soil tests to determine the kinds and quantities of fertilisers needed under different conditions. The physico-chemical condition of soil is important. Incomplete response to fertilisers may happen due to poorly developed root system.

No single factor can affect crop production to the same extent as the provision of controlled irrigation in areas where it is needed. Fertiliser application depends upon adequate and timely water supply. In Japan 95% of paddy area is under some type of irrigation. Our Third Five Year Plan provides for an expansion of nine million hectares in the gross irrigated area. Flood control projects can cover an additional two million hectares.

Double cropping or harvesting of two crops e.g. rice is technically possible by means of a fuller development of irrigation potentialities and proper drainage. It balances labour load and is considerably cheaper to provide perennial work. On well drained land cropping patterns can be adopted to get maximum yield during a year from a given piece of land.

Improved agricultural practices will go a long way to maximise production. Small scale subsistence farmers are often too conservative to use improved techniques. Land tenure conditions such as share cropping, poor water control, absence of credit facilities impede or prevent adoption of better practices including use of fertilisers.

Price incentive is another factor. High price to farmers act as an incentive to higher production. Government should have price support policy. Effective guaranteed minimum or official procurement price helps increase in production. Ceylon has deliberately supported Farmer's Price to stimulate production. In Japan the price of crops has been kept high as a general guarantee of farm income.

Package plan—A special feature of India's Third Five Year Plan is package programme. This involves concentration of efforts to raise yields in selected districts of high potential growth. This scheme has to be extended to cover larger area to maximise production.

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3. SRI T. NATARAJAN (Madras) :

In the Third Five Year National Plan 30 to 40 per cent higher targets of Agricultural Production, over the achievements in Second Plan have been set as indicated below :—

| | | | |
|----------------------------|----------|---------------------------|------|
| 1. Food grains (M. Tons) | 100-105 | 9. Pepper .. ('000 Tons) | 30 |
| 2. Oilseeds .. (M. Tons) | 9-9.5 | 10. Cardamom .. | 2.62 |
| 3. Sugarcane .. (M. Tons) | 9-00-9.2 | 11. Lac .. | 62 |
| 4. Cotton .. (M. Bales) | 7.2 | 12. Tobacco .. | 325 |
| 5. Jute .. (M. Bales) | 6.5 | 13. Tea .. (M. lbs.) | 850 |
| 6. Coconut .. (M. Nuts) | 5750 | 14. Coffee .. ('000 lbs.) | 80 |
| 7. Arecanut .. ('000 Tons) | 100 | 15. Rubber .. ('000 lbs.) | 45 |
| 8. Cashewnut .. | 150 | | |

After World War-II, India was trying for self-sufficiency in food grains but with only partial success. However, Agricultural production during the past 10 years (2 plan periods) had increased by about 30 per cent. In the Third Plan it is hoped to attain self sufficiency in food grains and achieve 30% overall increase in all other Agricultural Commodities together in order to meet the needs of the growing industries and for export. Increased Agricultural production is, therefore the key for rapid Economic development of India.

2. The success of maximising Agricultural production, however is dependent on the adoption of Scientific methods, fuller utilisation of manpower in rural areas, through local efforts and reorganising rural economy on the co-operative pattern.

3. For maximising Agricultural production, the following scientific methods and techniques, well known for increasing production, have been introduced in different States in India with varying degrees of success.

(a) *Improved seeds* : Several improved strains of crops have been developed giving on an average of 10 per cent increase in yields, besides possessing better quality, disease resistance or resistance to adverse conditions of cultivation. However what is necessary is a coordinated system of regulated multiplication and distribution of these for saturation of crop areas and periodic renewal of seeds. States should develop a seed certification service also for an effective seed programme.

(b) *Local Manurial resources* : While the requirements of all crops grown can be roughly estimated at about 6 million tons of Nitrogen, the total local (Organic) manurial resources available may be about one million tons, while the potential in the form of F.Y.M., Compost, Green Manures etc. may be upto 10 to 12 million tons. The development of local manurial resources even to the extent of doubling, is a slow process and may have to be planned over a longer period—20 years or more. This requires the local cooperation and effort and rightly Government have brought in the village Panchayats for this purpose in several States.

(c) *Fertilisers* : For immediate increase of crop yields fertilisers are very necessary. By local production and imports, the required quantities have to be made available urgently. Agriculturists have now become fertilizer conscious in several States in India. Yield increases from 20 to 40 per cent are recorded. There is also no risk from the continued use of fertilisers, especially if balanced fertilisation is practised.

The use of fertilisers indirectly increases the organic matter resources in the soil (roots, stubble) and for composting (straws) thus leading to a harmonic utilisation of manures and fertilisers.

(d) *Improved implements* : It is necessary to rapidly develop on a large scale, useful tillage implements for better tillage for better crop production and for

labour saving, in all Agricultural operations. Bullock drawn implements are needed. Existing facilities are very meagre compared to requirements.

(e) *Plant Protection* : Development of plant protection measures—prophylactic and curative—is necessary to prevent loss of Agricultural produce as over 20-25 per cent of crop areas is usually subject to pests and/or diseases. The required pesticides and equipment have to be imported and indigenous development also planned rapidly.

(f) *Soil and water conservation* : In areas where Agriculture is mainly dependent on rainfall of the area, soil and water conservation measures are of prime importance and take precedence over other technological improvements. Without these, the improvements advocated would not be fully utilised nor be efficient. Besides increasing soil fertility and crop production, these measures improve underground water resources. Efforts should be made to carry out these measures through local people; the Government providing technical guidance, Education and Finance for the changes needed.

(g) *Improved Agronomic practices* : These include composite agronomic practices a "Japanese method of paddy culture," Bombay dry farming system etc. These have regional application, require considerable modification even within small areas, and greater education through Demonstrations. These have not made much progress due to various limitations, in different States.

4. The usefulness and rapid utilisation of Agricultural techniques for increased production, depend upon suitable development of (a) organisations and also (b) institutional reforms :

(a) *Organisations* : In several States, the provision for research and training of technical personnel is inadequate for the task that lies ahead. It is necessary to train more persons for research and extension. Extension service should be expanded greatly and integrated with research and teaching; the regulatory and supply functions being kept separate as far as practicable.

(b) *Institutional reforms* : Supervised credit should be made available to the large body of small farmers and this may be channelled through co-operatives.

For Agricultural supplies, in adequate quantity and in proper time, service co-operatives, have to be developed besides private industries to discharge the functions effectively.

It is also necessary to develop market services—co-operative and regulated—to reach the villages, so that, the producer receives due prices for his produce.

5. *Incentives for Agricultural production* : Fixation of minimum prices for all important crops and announcing them well in advance of crop seasons, will induce investment for increased production.

Similarly in respect of land tenures, cultivators-owners and tenants—should be assured of conditions which will favour investment for higher production.

6. The problem of increased Agricultural production does not consist merely in the advocacy of improved Agricultural techniques but it embraces a variety of human and social aspects as well. It is in this context that the Community Development Programme has an important role to play. Of course, the Community Development Organisation should be so reorganised as to be effective in supplies and services to village Panchayats and Co-operatives, to maximise Agricultural production.

Besides exchanging views and experiences on the various Agricultural techniques adopted in several States, the Agricultural Scientists assembled, may express and exchange views on the other aspects—organisational and institutional—that influence fuller utilisation of the techniques.

4. SHRI R. GHOSH (Calcutta) :

Population pressure in the State of West Bengal is high and scope for bringing further land under plough is limited. The question of productivity per unit area assumes very great significance in such areas. West Bengal in this respect presents a rather distressing picture of low yields of crops and major area being only single cropped with aman paddy.

Climate, soil, nature of crops and their varieties, irrigation, drainage, manurial, cultural and others are all factors that determine the limits to which crop yields can be increased. In West Bengal and in the major cultivated area in north-east India, maximisation of crop yields will largely consist of effecting yield increases in aman paddy only. Work in India appears to indicate certain limitations of yield increases with the existing varieties. The limit is attained at fairly low levels of fertilizer application even when the percentage of actual utilization by the crop of applied nutrients, is low.

Aman paddy with its seasonal peculiarities offers very little scope for introduction of kharif or rabi crops in a cropping programme. Particularly where aman yields are low, the production can be increased substantially through a substituted and more intensified and diversified cropping pattern. Introduction of crops like aus, maize, jute, oilseeds, pulses, sugarcane, wheat, potato, forages and legumes, green manure crops etc. in a suitable rotation require particular attention in this respect.

Irrigation or assured water in the above respect offer outstanding opportunity for locating suitable crops in a cropping programme on scientific lines that will result in maximisation of production. This is of vital importance for proper land use; maintenance of soil fertility; effective utilisation of labour, capital, implements and farm power; crop insurance; year round employment and better farm returns.

Great stress is being laid on irrigation (tube-well, river pumping, river valley projects etc.) in West Bengal which will open up effective means of increasing the production which very largely has to be through a change in crop pattern with more stress on increased cropping intensity.

5. DR. M. V. MACHANI (Cuttack) :

In conclusion it may be stated that the problem of low productivity of land and instability in food supplies has to be tackled immediately and the knowledge already available at our disposal has to be utilized for increasing the food production. It is true that ours is a large country with wide variation in climatic and soil conditions due to which it is difficult to generalise the recommendations for improvement of crop yields. Hence research has to be intensified in all directions viz. evolution of new varieties, improved methods of cultivation, cheaper and more efficient use of manuring and newer and effective insecticides and fungicides in different soil climatic and environmental conditions. But various ways for increasing the rice production indicated above can be put into practice with certain modifications in the light of actual observations to suit the local conditions. These methods of cultivation have been advocated by the Agricultural Departments but these have not been adopted on any large scale particularly in case of food crops. This is mostly due to the low-purchasing power and poor economic condition of the grower of the food crops due to which he is not in a position to invest any capital for the purchase of fertilizers, improved seeds etc. Moreover in India farming is not carried out on commercial principles but is only a way of life and as such the cultivator has neither the will nor the means to invest any capital for improvement of land.

The other bottleneck in improving the crop yield is, however, the wide gap between research and extension and the failure to put into practice on a sufficiently large scale, even simple results, which have proved beneficial. Attempts to change the present position should be directed along the reorganising and reorienting the extension work, creating an army of volunteer propagandists from the villages, arranging for a more intensive multiplication and storage and improved seeds and other supplies to the cultivators in the villages and making them available on easy credit basis.

Therefore, for implementation of any agricultural improvement programme the participation of the cultivator has to be secured by offering him some economic incentive by way of assuring him the minimum price for his produce. Besides establishment of village service co-operatives for timely supply of seeds, fertilizers and other requirements would go a long way in improvement of the standard of cultivation.

6. SHRI DAMODAR MISRA (Bhubaneswar) :

This problem of maximisation of Agricultural production has been receiving the attention of scientists, administrators and politicians since the last 100 years. Most of the suggestions made in this house have been known to us at least 15 to 20 years ago. But in spite of this knowledge, the cultivator has not accepted or adopted the findings of science. The central minister has, therefore, stated that the scientists have failed to bring any impact on the Agricultural production and National Development. One of our previous presidents has remarked that we have neglected to study the cultivator and his problems.

It is accordingly suggested that apart from research work for increasing production which should continue, studies should be initiated to find out the problems which preclude large scale adaptation of the research results with a view to stimulate the farmer for accepting the research findings for increasing production.

7. DR. K. P. SENGUPTA (Kalyani) :

One of the ways to maximise agricultural production is to take more than one crop in a year from the land which is at present producing only one crop. It has been found from actual experiments that under the climatic condition of West Bengal it is possible to raise three crops from the same land in a year with the help of perennial irrigation provided by deep tube wells. It is possible to introduce a variety of crops in this triple cropping programme including green manure crops and fodder crops. A green manure crop is essential at least once every two years if such intensive cultivation is done in order to maintain the productivity of soil. A leguminous fodder crop as one of the three crops will not only provide more nutrition to animals but also enrich the soil. It is thus possible to introduce mixed farming in perennially irrigated areas which will increase the production of food and feed and the green manure crop and cowdung saved will go to increase the fertility of soil and sustain it at high level.

Three crops raised from the same land in a year for two successive years are shown below :

1st year—Jute followed by transplanted aus paddy followed by wheat.

2nd year—Aus paddy (line sown) followed by Kalai for fodder and gram followed by potato.

The yield of Jute was 33 mds. per acre, that of transplanted aus paddy 25 mds. per acre and that of wheat 20 mds. per acre. The yields per acre of the

three crops raised in the second year are 25 mds., 250 mds. and 200 mds. respectively.

It will be seen from above that it is possible to increase the production per acre considerably. From actual experiments we have found that it is possible to make a net income of Rs. 1,000/- to Rs. 1,500/- per acre from different triple cropping programme.

8. SRI JAGANNATH HOTA (Cuttack) :

For maximization of yield, apart from the work and results on land and land productivity and the methods involved in extending the same to the cultivators we have to take into consideration the following main points from the cultivators' point of view.

(1) *Organization of better facilities for financing Agriculture* : Improved methods leading to maximization need more investment of money. Adequate arrangement needs to be done in this direction. Low investment cannot lead to more production.

(2) *Mechanization leading to labour replacement* : Labour was very cheap in the past and the present labour wages are considered somewhat high but time is coming when the wages will rise much higher. A cultivator knows that timely sowing and other agricultural operations will have magnificent results but he would not be able to carry out his operations in time because of lack of labour. We have therefore to adjust ourselves in this direction.

(3) *The cultivator as a manager* : Our cultivators are not well educated. If educated they do not stay in the line because it is less paying than many other professions. There has to be devices, therefore, to attract intelligent and educated people to the field of agriculture. A cultivator from his earnings should be able to own a good house, a comfortable and quick conveyance and should be able to pay for good education for his children and for the maintenance of the health of his family.

The fixing of ceiling on agricultural holdings with the idea of providing a modest living for the farmer will not attract intelligent people to agriculture. As a matter of fact if a farmer, and his family can manage with their own labour and with the help of suitable machinery certain piece of land he should not be deprived of the same by way of fixation of ceilings.

In the matter of getting income from agricultural enterprises Dr. Sen, our President, has suggested with the help of data obtained from certain parts of Burdwan that it is possible to expect an average proprietor-farmer-manager-worker of India to get an average income of Rs. 600—1,000 per month from an average holding of 10—15 acres.

9. DR. B. CHOUDHURY (New Delhi) :

It is suggested that efforts should be made to modify the cropping pattern and the food habit of the people. Agricultural crops which produce 10 to 20 times more than the general cereal crops both in quantity and nutritional quality should occupy more and more area. These are vegetable crops. To meet the demands of the growing population it is but essential that more area should be put under vegetables and people should acquire the habit of taking more of vegetables. It is well known that better seeds, better agronomical and plant protection methods can increase the yield per unit area. In addition to these two other methods are suggested. The first is use of hybrid F₁ seeds in crops like tomato, brinjal, onion, bhindi and cucurbits where 30 to 200 percent increase has been recorded. The

use of male sterile lines to decrease the cost of hybrid F_1 seeds is also suggested. The second suggestion is the use of plant regulators in vegetables like tomato, brinjal, cowpea and cucurbits. For maximisation of agricultural production we must have to pay more attention to vegetable crops which has so far been neglected in our country.

10. DR. S. GOVINDASWAMI (Cuttack) :

For Maximisation of Agricultural production the primary requisite is the availability of high yielding varieties. In this direction, in rice, many high yielding strains have been evolved both by selection and hybridisation. The *indica* \times *japonica* hybridisation programme initiated at the central Rice Research Institute, in recent times, is a significant advance in this direction. But even some of our local varieties (especially collected from some unexplored areas) are capable of giving high yields. This is also evident from the fact that many of the high yields obtained by Krishi Pandits in crop competitions are through the use of local varieties, in combination with other suitable cultural methods. Therefore the evaluation of our indigenous varieties for high yields is very necessary. These varieties can be directly introduced with profit for boosting up yields.

Work done by Dr. Richharia and his associates at the Central Rice Research Institute has shown that tiller separation and stubble planting can give increased yields up to 17 to 61 per cent, in rice. This technique also can profitably be used for maximisation of rice yields.

11. PROF. J. J. CHINOY (Ahmedabad)

The problem of maximisation of crop production can be divided into two facets : (1) Research work to determine the optimum combinations of factors governing crop production for obtaining maximum yield, and (2) application of results of research to farm practice on country-wide basis.

As the second facet involves a number of problems of agricultural economics it is not dealt with here. As regards determining optimum conditions for getting maximum crop yield per acre it may be pointed out that none of the speakers at the symposium had stressed the importance of complex factorial experiments which take into consideration the physiological interactions of major factors like manuring, watering, spacing, time of sowing and others. Even upto the present day single factor experiments are generally laid out on fields of agricultural research institutes and stations.

A survey of experimental work done in India reveals that there is paucity of experimental evidence on the optimum combination of factors and their interactions for the numerous crop plants and their varieties growing in this country of ours. Consequently the extension work for introducing correct farm practice has failed. A number of instances of such failures can be cited. One well known example is "the Periodic Partial Failure of American Cotton" in undivided India. This problem was solved by the late Professor R. H. Dastur by applying the technique of complex factorial experiments and supplemented by late Professor F. G. Gregory's method of growth analysis.

In conclusion it is suggested that agricultural research institutes and stations should include on a large scale complex factorial experiments on different crop plants supplemented by growth analysis with a view to determining the optimum combination of factors and their physiological interactions. Data from a large number of such complex field experiments can only entitle them to tender advice to the farmer.

12. SHRI ANIRUDHA MISRA (Cuttack) :

Different speakers have spoken about different aspects but one—the problem of weeds. Weeds are there since the beginning of Agriculture. Crop plants and weeds compete for same type of requisites for growth—i.e. nutrition, space, light etc. So unlike Pests and Diseases which are parasites on crop plants—the weeds are the brethren of the crop plants and compete for same needs. In this competition weeds win.

The loss due to weeds alone is more than what it is due to Pests, Diseases, Birds and Animals and animal diseases put together. We do not have any statistics for this. In U.S.A. they have found out that it is 40-50 per cent on an average and may be cent per cent. The weeds work as a double edged sword. They reduce the crop yields and cause farmers to spend more to remove them.

There is shortage of labour in the villages due to developmental work of Five Year Plans. Cost of removal of weeds has gone up from 50 per cent or more of total cost of cultivation. In Europe and America large scale chemical control has been started by Government or by Crop Insurance organisation. It is high time that we devote more of our time and resources to study and solve this problem of weeds and by that alone we can increase yields by 40–50 per cent.

13. N. K. CHAKRABARTI (Cuttack) :

By controlling the spread of the diseases yield of the crop can be increased to a considerable extent.

1. Helminthosporium disease of rice can be controlled by spraying/dusting fungicides. Experimental records in West Bengal show that helminthosporium can be controlled by spraying rice crop with 'Perenose' (copper fungicide) in a large area in cultivator's field.

2. Resorting to 'low volume' spraying the cost of fungicides can be reduced to 1/5th of the cost under 'normal volume' spraying of rice crop, and this is economical from the point of view of 'net' return of the yield obtained by controlling the disease through spraying fungicides.

3. Judicious application of fertilizers (nitrogenous) is necessary to minimise the incidence of diseases.

4. Varieties resistant to the diseases should be used wherever available. A number of rice varieties resistant or moderately resistant to blast and helminthosporium are available.

5. Establishment of disease forecasting units in different areas are necessary, so that cultivators can be given warning regarding the appearance of diseases, so that the plant protection measures can be resorted to in time.

14. SRI G. C. SEN GUPTA (Cuttack) :

The main reason why the Agricultural Scientists have failed to make their impact on food production and national development is the lack of trained personnel in the extension organisation. Unless the extension organisation has adequate staff trained up to the graduate level in different branches of Agriculture it will not be possible to educate the farmers in improved practices of Agriculture. There can be only better dissemination of scientific knowledge to the cultivators through the extension staff having well trained technical staff. When the farmers are convinced by well planned demonstration they will adopt modern scientific methods which will contribute a great deal towards this maximisation of yield.

15. SRI P. ISRAEL (Cuttack) :

Control of pests in rice crop is an important contributory factor for "Maximisation of Agricultural production". By adopting a rational method of controlling stem borers by spraying insecticides to synchronise with the emergence of broods, the incidence of stem borers can be reduced by 84% and the yield can be increased by 54%. Whatever methods are used for maximisation, adoption of plant protection measures gives still higher yields.

In an experiment at the Central Rice Research Institute, the following results are obtained :—

| | Yield per acre |
|---|----------------|
| Unmanured | 971.00 lbs. |
| Manured (40 lbs. Nitrogen and 32 lbs. P_2O_5) | 1791.00 " |
| Manured and sprayed | 2368.00 " |

In breeding varieties for maximisation, it is desirable that characters responsible for resistance to pests should be taken into consideration. Experiments at the Central Rice Research Institute indicated that the less susceptible strains are characterised by thick bands of lignified sclerenchymatous tissue in their stems with narrow lumen. In the more susceptible varieties the sclerenchyma is poorly developed.

16. SRI SITARAM MISRA* (Bhubaneswar) :

Maximization of Agricultural production should also include quality of the food i.e. besides the yield in quantity equal importance should be placed on the food value of the crop, and accordingly breeding programme should be followed.

17. SHRI K. PULLAJAH (Bhubaneswar).

While maximising production qualitative factors such as size, taste, colour, aroma, appearance etc., and the economic aspects also should be taken into consideration. How, where and when to maximise the agricultural production are some of the problems confronted by the scientists to-day. Both "vertical" and "horizontal" ways to maximisation of production should be done simultaneously. The "vertical" or intensive method of maximisation includes use of improved seeds, implements, more manures, fertilisers and irrigations in addition to the use of improved technique and agronomical practices. In this case the land is kept constant and more labour and capital are added for maximising yields. In "horizontal" or extensive method more land is brought under plough by way to reclamation and usage and all the factors of production or resources are simultaneously used.

Maximisation of production must occupy the maximum financial gains to the cultivators and the laws of economic returns should also be observed. Plant protection does not form one of the methods to maximise production as stated by Dr. Narayanan but prevents damage to a crop or product. Hence it need not be universally adopted or the entire area covered since it adds more cost to the production. But effective steps should be taken only where a pest or disease appears.

Another point is that the cost of the increased yield should not exceed the market cost of the same product. Effective use of land and efficient use of labour, capital and capital equipment are the primary requisites in maximising agricultural production.

The discussion ended with a vote of thanks by the President given to the contributors and speakers.

II. WATER REQUIREMENTS OF CROPS

Chairman : PROF. P. K. SEN (Calcutta)

1. PROF. J. J. CHINYOY (Ahmedabad) opened the discussion.

Ensuring adequate supply of water for the optimum growth and development of crop plants is one of the important problems confronting cultivators in arid regions of our Country. As the amount of water available for irrigation is generally limited in quantity it is necessary to regulate its use scientifically so as to obtain the best economic return.

A little confusion appears to have arisen in the use of the term 'water requirement' by different workers. It is, therefore, necessary at the outset to obtain a correct perspective of the subject under discussion. The term 'water requirement' of plants was first used by Briggs and Shantz (1914) to denote 'the ratio of the weight of water absorbed by a plant during its growth to the weight of the dry matter produced exclusive of the roots.' This term has replaced the term 'Coefficient of Transpiration' suggested earlier by Hellriegel (1883). Maximov (1929) considers the phrase 'efficiency of transpiration' (Productivität der Transpiration) which was originally suggested by Ivanov (1913) as more suitable because 'the determining process is transpiration and the determined the amount of dry substance'. It is more convenient because an increase in the figure denoting the value of the ratio actually corresponds to an increase of efficiency per unit of water used, while according to the usual terminology, an increase of efficiency is accompanied by a decrease in the figure representing the ratio. He has expressed 'efficiency of transpiration' by taking the ratio of the amount of dry substance produced by the plant for every kilogram of water expended. Thus the reciprocal of 'water requirement' multiplied by 1000 will give the value of 'efficiency of transpiration'. Very often experiments for determining the duty of irrigational water for different crop plants are also termed as 'experiments on water requirement of crop plants.' This leads to confusion especially when relationship between the 'water-requirement' as defined by Briggs and Shantz and the level of water duty is to be established. It is, therefore, proposed to use the term 'water requirement of Plants' exclusively as suggested by Briggs and Shantz.

A review of work on water-requirement of plants clearly brings out the fact that this so-called index of drought resistance in plants is not a constant because it is mainly dependent upon the amount of water transpired by the plant. All the factors influencing transpiration and other physiological processes of the plant would therefore influence the magnitude of water requirement. After a prolonged investigation Maximov and his collaborators came to the conclusion that a large number of plants growing in dry regions had exceptionally high rate of transpiration. Thus such plants were no economisers of water but wasters.

Considering the above mentioned facts it appears that the most fruitful line of research in this subject is to determine the most economic use of irrigation water for optimum crop production. Numerous instances in published work as well as in the records of various research stations of our country can be cited in which different levels of watering have been studied without taking into consideration the nutritional level of the soil, time of sowing and spacing. Such single factor experiments cannot give a correct estimate of the irrigation water required by the crop under different soil and climatic conditions because they are based on the erroneous assumption that each of the contributing factor has an independent action of its own on crop production. Optimum combinations of different agronomic factors can only be obtained by carrying out complex factorial experiments. Another advantage of such complex factorial experiments is that the interactions of factors can also be studied. Another important aspect of the complex irrigation experiment is the technique of growth analysis developed by Professor F. G. Gregory

and his co-workers. Growth analysis has been successfully applied to complex field experiments for obtaining further confirmation of yield data.

Many instances can be cited of the successful application of the above-mentioned techniques and benefits accruing to the cultivator from the application of results of these experiments. One such outstanding example is the solution of the problem of irrigated cotton in the Sudan by Prof. F. G. Gregory. Practical application of the results of Cotton Physiological Scheme sponsored some years back by the Indian Central Cotton Committee under the guidance of Professor R. H. Dastur at Lyallpur (in undivided India) is also another example of what can be achieved by following the proper technique.

2. SHRI A. P. BHATTACHARYA (Roorkee) :

If we trace the history of civilization of mankind we find that the culture and care of crop plants marked an important step in his progress, for he had then crossed the primitive stage—leading a nomadic life and hunting and fishing for a living. When man started growing plants, he needed a home and from there onwards he was on the path of civilization. Land was there for the asking, and man could grow enough food for his tribe.

Of late, however, the pressure on land started growing, while the means of subsistence (from crops) could not grow at the same level. This is really the era when we have been forced to think about maximizing food production.

Everyone knows how essential water is for crop production. It is also well known that the best source of water is from natural precipitation. When, however, this is not sufficient to meet with the watering needs of the crop or its behaviour is erratic or subject to fluctuations during the growing season that we resort to supplemental irrigation for fulfilling the water requirements of crops.

In the case of deficient watering, crop production naturally suffers. It is, however, not always appreciated by the layman that when more water is applied for irrigation than necessary, the excess is not retained by the plant. This escapes to the ground water table, carrying with it in solution valuable plant food which is thus wasted. Proper water management is therefore a prerequisite for successful irrigation practice and consequential crop production.

For the determination of water requirements of crops, there can be several possible methods out of which experimental determination is the most direct and accurate. This was adopted for the determination of water requirements of three principal crops of Uttar Pradesh, namely, rice, wheat and sugar cane, work on which was initiated in 1942-43. In this series of experiments, an attempt was made to isolate the effect of watering, keeping all other factors more or less constant, in order to arrive at the optimum combination of the level and frequency of irrigation for obtaining the maximum yield.

Several empirical formulae were also tried for the assessment of water requirements from climatological data. Blaney-Criddle formula was found to be the most practical and consistent for adoption.

Out of the net cultivated area in the country, 20 per cent is irrigated, where the wasteful use of water is being practised freely. This is minimizing the yield by at least 20 per cent, the enormity of which can well be imagined. This works out to the order of several crores of rupees. For all irrigated regions of the country, it is therefore imperative that immediate steps should be taken for taking to proper water management, prerequisites for which are the initiation of an extensive series of experiments on water requirements of all important crops and the dissemination of the knowledge to the cultivator who should be induced to make the correct use of water for irrigation, which will augment his crop yield, improve the quality of the crop and revolutionize the economy of the country which will be converted into a completely self-sufficient area (in food).

3. DR. S. K. MAJUMDAR (Cuttack) :

The study of the water requirement of any particular crop plant has two major implications; (a) *Agronomical*—where the nature of the soil, manuring, crop variety and its duration are studied in relation to meteorological factors and available irrigation facilities, and (b) *Physiological*—where those intrinsic factors are studied that enable a plant to withstand periodic drought conditions with the least or no reduction in the yield. The present discussion concerns itself strictly with the latter aspect of the study with reference to rice plants.

It has been reported that an amount of 25"-30" total rainfall is required for a successful crop of a rice variety of about 125-135 days duration. The problem of drought is, however, encountered in a rainfed upland crop in a season when the distribution of rain is unfavourable and plants are subjected to drought conditions at a critical time in their growth cycles. Earlier reports on morphological adaptations such as root system, stomatal frequency and transpiration rate in a variety of rice do not indicate any correlation between these characters and actual drought resistance capacity of that variety in terms of final yield under periodic drought. The physiological basis of drought resistance in rice, therefore, must be sought elsewhere.

It was reported that heat-stability of chlorophyll in a variety is an index to its drought-resisting capacity. Unlike a drought-resistant variety, the yield of a drought-sensitive variety is drastically reduced when grown under periodic drought conditions. It is, therefore, conceivable that chlorophyll synthesis and photosynthetic efficiency, which are responsible for satisfactory yield potential of a variety, have some close relationship with the actual drought-resisting capacity of that variety in terms of final yield. Results of the work in progress at Central Rice Research Institute, Cuttack, indicate that the heat stability of chlorophyll of a rice variety is correlated with its drought-resisting capacity.

4. DR. S. D. NIJHAWAN (Ludhiana) :

1. Water logging. Water logging in the Punjab is not only due to excessive use of it by cultivators but due to seepage from the canal bed and due to up-setting of natural drainage due to construction of railway lines, roads and canals.

2. No mention has been made to relation of soil to water requirement of crop. It is very important problem. It will help us in finding out the optimum quantity which should be stored in the soil to get maximum yields.

3. Time of application of irrigation water to different crops. It is another important problem. When irrigation water is applied at certain stage of the growth of a crop, it is possible to obtain maximum yield of a crop. This work has been done in the case of bajra, guara, wheat and gram.

4. It is a wrong conception that the water requirement of crops is increased by the application of fertilisers

The President thanked the contributors and speakers.

III. RECLAMATION OF WASTE LANDS

Chairman : PROF. P. K. SEN (Calcutta).

1. PROF. N. R. DHAR (Allahabad) opened the discussion.

Prof. Dhar pointed out that the Statistical Department of the United Nations unequivocally declared for three consecutive years from 1956 that India was the hungriest country in the world, as the caloric intake is of the order of 1620 per

capita and the animal protein consumption per person per day is only 5.6 gm. as against 28.00 calories and 30 gm. needed. Prof. Dhar also remarked that experiments carried on in Europe and America show that one kilogram of nitrogen applied to crop production produces 15-16 kilograms of cereals, whilst in India, paddy production is ten times the weight of nitrogen added to land. The response to phosphate and potash of crops is almost one-fourth of that of nitrogen. The world production of cereals to-day is 1,000 million tons, good food production is 700 million tons and fodder production is 1,600 million tons. For producing these materials in the whole world, not less than 250 million tons of nitrogen as nitrogenous compounds are necessary, but the world supply of factory nitrogenous fertilizers is only 8.8 million tons. In India to-day 70 million tons of cereals are being produced; this requires approximately 7 million tons of nitrogen. But Sindhri and other factories are manufacturing not more than half a million ton of nitrogen as chemical fertilizers. Hence chemical fertilizers are completely inadequate to meet the nitrogen need of Indian and world agriculture. The Chinese and Japanese do not waste any organic matter and utilise weeds, animal and human dung and other wastes in crop production along with chemical nitrogen. It has been observed all over the world that artificial nitrogenous compounds are more effective when the soils are rich in humus (organic matter). This is the reason why the response to crops of nitrogen seems to be greater in Europe than in India. Hence for intensive cultivation a mixture of inorganic nitrogen and organic matter have to be utilised. Moreover, Dhar and coworkers have observed experimentally that the oxidation of soil humus is increased by applying to soil organic and inorganic nitrogenous fertilizers and manures. The chief source of the soil nitrogen is the slow photo chemical and thermal oxidation of organic matter aided by sunlight and phosphates.

For over 30 years, Dhar and coworkers have developed a method of land fertility improvement and reclamation of saline and alkaline and waste lands all over the world by the application of all types of organic matters mixed with calcium phosphates. As organic matters, molasses, pressmud, cane leaf, cane trash, weeds, grasses, straw, leaves, *kans*, water hyacinth, *cactus*, sawdust, peat, coals, etc., have been profitably applied in fixing atmospheric nitrogen in the land and increasing the humus capital. For phosphates, bone, superphosphate, all basic slags from our expanding steel industries (Tata, Kulti and Durgapur) containing 4 to 10 per cent P_2O_5 , plenty of lime, magnesia, manganese, potash and other useful plant nutrients have been utilized with great success. By this method large areas of saline and alkaline and waste lands have been reclaimed in Rajasthan, and other parts of India. There is no need to powder the slags but in small lumps when mixed with organic matter the slags are dissolved to soluble phosphates, calcium and magnesium salt by the carbonic and organic acids generated in the oxidation of organic matter. Phosphating of organic matters is certainly a very big step in improving the fertility of land permanently and reclaiming alkali and acid soils of the world. The organic matter like glucose present in molasses, cellulose and lignin present in straw, leaves, etc., undergoes oxidation when mixed with soil ($C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O + 673K \text{ cal.}$). The energy liberated decomposes water molecules present in soils into atomic hydrogen and OH radical ($H_2O + 112K \text{ Cal} = H + OH$). The atomic hydrogen being highly reactive directly combines with nitrogen forming ammonia and thus the nitrogen status of the land is enhanced by organic matter. In this process sunlight is absorbed and leads to greater fixation of atmospheric nitrogen. Calcium phosphates also improve markedly nitrogen fixation by applying organic matter not only when ploughed in land, but also Dhar and coworkers have observed that the total nitrogen content of ordinary composts is 0.5 to 1 per cent, whilst phosphated composts contain 1 to 1.2 to 2 per cent total nitrogen. Light enhances the nitrogen content of composts. So does phosphates.

2. DR. S. P. RAYCHAUDHURI (New Delhi).

Land which have either gone out of cultivation or have never been brought under cultivation may be classed as waste lands. Under this class may be placed (1) barren and uncultivable lands and (2) cultivable wastes. The problem of reclamation of waste lands involves bringing mainly the cultivable wastes under cultivation.

The population of India according to 1961 census is 438 millions. The *per capita* cultivated land area is 0.73 acres, whilst cultivable waste land (excluding fallow) *per capita* is 0.127 acres. The *per capita* cultivated land area in India is very low, as compared with other countries, with the exception of China. On the top of this, the productivity of Indian soils is at a very low level with the result, that a large percentage of our population is either underfed or is suffering from malnutrition. The increased production of food grains aimed at in the Third Five Year Plan over that achieved in the Second Plan (79.3 millions) is 20.7 million tons.

The total cultivable waste lands in different states in India is about 54.9 million acres. The cultivable waste lands, if brought under cultivation, can be one of the important factors for augmenting the Country's production. The chief reasons for leaving such lands uncultivated are :—

- (1) Deep rooted grasses and weeds.
- (2) Unhealthy conditions, chiefly due to malaria.
- (3) Lack of drainage.
- (4) Low fertility of the soil.
- (5) Lack of water supply.
- (6) Salinity and alkalinity.
- (7) Damages by wild animals.

Some area of the cultivable waste lands infested with deep-rooted grasses and weeds were reclaimed by the Central Tractor Organisation and by the states by tractor ploughing. For planning reclamation work it is necessary to ascertain what proportion of cultivable waste lands can be brought under plough, and under what conditions. A rapid preliminary survey of all such areas will be helpful in drawing up of project plans for this reclamation. More detailed survey for specific areas may then be undertaken to draw up the execution plans for individual blocks. For carrying out rapid preliminary survey of the wastelands the technique developed in the Maharashtra State may be used. In this system the land is divided into four classes :

A Class :—This class of land is one which is suitable for cultivation without special practices. It is nearly level land, well drained and should produce at least an average crop. No special soil conservation measures are needed except following the usual methods of good cultivation.

B Class :—This class of land is suitable for cultivation with intensive cultural practices. The land slope may vary from 16 to 8 per cent and should have adequate depth of soil with a minimum of 6". The land may have been affected from ordinary sheet erosion to gully erosion.

C Class :—This class of land is not suitable for cultivation* and requires severe restrictions in its use from soil and moisture conservation point of view. Such lands are of steep slopes of more than 8 per cent, rough, highly eroded, with very little soil left. Such lands are suitable for afforestation. This class of land should be capable of giving a good yield of grass.

D Class :—This class of land has less than 6" of soil with highly undulated terrain and uneconomic to develop.

While the class A land may be straightway brought under irrigation without any soil conservation measures, it is the class B land which may be profitably brought under cultivation. In recent years the Ministry of Food and Agriculture set up a Wasteland Survey and Reclamation Committee for locating areas where large blocks of such lands are available for reclamation and settlement and also suggest suitable methods for reclamation and colonisation. This Committee is bringing out the reports of individual states which contain very useful information about the occurrences of such lands in big blocks in the states. A rapid survey for the location of smaller sized cultivable wastelands is also under the consideration of the Government of India.

The techniques of reclamation of the B class cultivable waste lands have been worked out but needs further study for making the techniques more effective.

3. DR. S. K. MUKHERJEE (Calcutta).

In West Bengal there is 2.97 million acres of land which are not available for cultivation. These comprise of forests, ravine, eroded lands and lands not suitable for cultivation, but can be brought under cultivation with suitable measures. Lands which are fallow, mostly occur in small blocks of less than 50 acres, but few do exist which are quite large and are now either barren or support some vegetation which is sparse.

The reason for these lands lying fallow can be either due to lack of water resources or due to salinity. The land which suffers from drought has long been undergoing erosion due to the heavy rainfall in these regions. Experiments show that they need conservation measures and at places need suitable amendments to correct the acidity formed. At places the rockbed or the underlying morum has been exposed as a result of the entire soil cover being eroded out due to different types of erosion. Experiments on reclamation show that it is essential to first check further loss, by suitable conservation measures and then try to develop these as forest lands. Partially eroded lands are to be first examined for their soil depth and nutrients needed and then to be put under different crops, depending upon the suitability of the land for the particular crop. The outcome of the reclamation of such waste lands may be bleak, because even if they are reclaimed or brought under cultivation, they may not produce an economic yield for the first few years.

In the saline tract we have quite a large area under sea water damaged lands which get submerged during high tide and come out of water during low tide. They sustain a type of vegetation, semi aquatic in nature and not much woody. At present such lands are being formed as a result of deposition of the silt interspersed with the salt layer brought down by the tidal flow and ebb. Experiments indicate that if we embank these tidal waters to prevent the high tides getting in the areas it may perhaps present a suitable area for reclamation. In West Bengal such reclamations are being experimented by the help of embankment drainage through sluice. The nature of drainage is either open or tiled drainage, depending upon the suitability of the area to be reclaimed. The water table is maintained at a suitable depth by the help of these. Under the tiled drainage system which are opened up in small rivulets which, in their turn, get into the sea by a sluice. It has been found that these saline soils lose their salts easily when rain falls and in about three to four years, become suitable for normal khariff operations. They invariably in the first year support a good, though patchy, paddy crop.

Use of soil amendments like gypsum has been found of not much practical use. The reserved calcium present in the soil is sufficient to convert the sodium

soil gradually into a good calcium soil. We expect that the entire estuarine areas of Sunderbans can gradually be reclaimed from the sea by this process, as our experiments indicate in certain regions of the coastal soils of West Bengal.

4. SHRI A. K. SARKAR (Calcutta).

With increasing population and against the background of limited area under cultivation, the problem of food supply is becoming acute in India. It has necessitated, extending cultivation into sub-marginal waste lands, which are low in fertility and have to be improved by modern farm practices.

Among cultivable waste lands of West Bengal the extensive span of lateritic uplands in the areas bordering Bihar and Orissa are of considerable importance. Here the cultivation is poor and is restricted to the rainy seasons only. There is no scheduled crop rotation; a single crop a year is general rule.

The pH varies round 5 and phosphates get fixed chiefly due to gradual dissolution of iron and aluminium oxides. Deficiency of organic matter in addition to the continuously deteriorating nitrogen level is a common feature for the soil of the region.

With a view to finding out a proper crop rotation schedule for this area commensurate with an economical fertilizer programme, the Department of Agriculture, Calcutta University, has started work at Seva-Bharati Farm, Dist. Midnapore, which is situated in the lateritic area, from 1957. In course of investigation the beneficial effects of phosphates and lime on crops, specially on legumes, have been noted. The work is now in progress.

5. DR. B. N. SAHU (Bhubaneswar).

Necessity :—Population is increasing. Personal income per capita and gross national product will increase as envisaged in five year plans. In the light of the rapid growth productivity of land must be increased. How rapidly and by what means this increase will be given effect to? Urban and suburb development is encroaching on agricultural land. Hence is the importance of reclamation of waste land.

Means to be adopted :—Wild life is largely an Agricultural Crop. In U.S.A. more than half of land area in the farms are used for production of food, fibre and wood products. Rest of the land produce most of the wild life that people hunt, watch or otherwise enjoy.

(1) Waste land can be converted into good wild life habitat. Land use may be adjusted to their capabilities. So such lands can be left in a natural condition instead of being destroyed by an attempt at cultivation.

(2) Wet lands and pot hole areas need not be drained out for cropping purposes. They prove unprofitable for cultivated crops. These can be used for wild life such as ducks, muskrats. Such lands should be developed with natural food and cover. It should be designed as nesting area for ducks and other birds or to attract and hold migrating water fowl by food planting. Areas can be drained during summer. Grain crops to be grown and then flooded to attract water fowl. Sudan grass, Johnson grass, Jobs tears, Cattails, Buttonbush can be grown to provide semiopen water landing areas for the water fowl. Pheasants, pigeons and doves will increase. Such areas can be auctioned for hunting migratory birds.

Earthfill dams and low-concrete and pipe structure can be built to control the water level and provide for training wherever necessary.

(3) Marginal lands can be utilised for tree planting. Trees will change the rough unsightly areas into a place of beauty and a heaven for wild creatures. Rabbits, quail, doves and pheasants partridges make the area their home.

Along with grass vegetation brouse-type of vegetation may be encouraged. The increase in brouse will favour deer. It has been seen that cattle prefer grass, sheep and goat prefer forbs while deer like brouse plants. Tree planting, brush control and seeding with grass will encourage deer and quail breeding rabbits, squirrels and pheasants will be plentiful.

(4) Sportsman club may be formed. Hunting bases may be granted. Such bases will form a good source of income. Good news will travel fast. Hunters will come from far and near.

(5) Small woodlots can be created. In the Tennesse valley of U.S.A. the marginal lands are being planted with Pine trees. A ten year programme has been taken up in Bowater County. The Pine trees will be utilised for pulp-making for production of news prints. In India there is a great shortage of news prints. To meet this shortage such a programme as that of Bowater County may be taken up for planting Casurina, bamboo, sabai grass in the marginal lands.

Organisation :—Field Service for utilisation of waste land may be formed by Government. In Israel Drainage Department of water planning for Israel Ltd. has been formed for dealing with water problem. This is a corporation in which the Israel Government is one of the major stockholders. So a waste land service of land utilisation Board may be formed in the line of Drainage Department of water planning of Israel. The method they will develop will be of local character. Local Councils may be formed. The waste land utilisation service will disseminate information and services related to waste land utilisation. The staff for each district will consist of an agronomist, laboratory assistants, field technician and a biologist. The staff will be under the control of Zilla Parishad. This organisation will be financed from their local taxes.

6. SHRI S. C. MANDAL (Ranchi).

Acid soils cover a large acreage in Bihar to the extent of 4 to 5 million acres and a considerable fraction of these soils is lying waste. These soils have very low productivity. A local paddy is grown year and year after with very poor yields. Other upland crops, e.g., maize, juar, groundnut, *rahar*, cotton etc. are not grown extensively as these soils support very poor crops even if they are supplied with NPK fertilisers. A series of experiments were started at Kanke Farm (Ranchi) in 1956 and carried over for five years with a view to making these soils productive. Lime was the principal soil amendment that worked out very successfully. With lime and fertilisers very good crops of groundnut, cotton, *rahar*, maize, juar, etc., can be grown. Some crops, however, did not respond to lime, the most prominent among them being paddy.

7. DR. R. N. SINHA (Banaras) spoke on the nitrogen fixation property of certain algaes and on their usefulness in the reclamation of alkaline soils of Uttar Pradesh.

The President thanked the contributors and speakers.

IV. UTILISATION OF AGRICULTURAL WASTES

Chairman : PROF. P. K. SEN (Calcutta).

1. DR. K. C. GULATI (New Delhi) opened the discussion.

The Government of India appointed a committee to investigate the efficient utilisation of waste food products and farm wastes. This committee made a detailed

survey of agricultural wastes and made suitable recommendations for their uses. According to this committee agriculture has to be run as an industry and for this investigations not only on agricultural food wastes should be taken up but also on the by-products of agriculture which are not utilised economically at present and do not bring suitable return to the farmers. This committee besides other materials recommended that investigations should be taken up on certain oils and oil cakes e.g. castor cake. The neem seed cake which is at present used extensively as a manure missed the attention of this committee.

There are conflicting claims in literature on the efficiency of neem seed cake as pesticide against certain pests of agriculture. Investigation in this regard is likely to yield fruitful results.

Among the non-edible oils the use of neem oil for industrial purposes occupies an outstanding position. However, its odoriferous character and higher percentage of unsaponifiables makes its refining prerequisite to its use as a substitute for edible oils for use in industry.

The problem of its high cost of refining may to some extent be eased by developing more remunerative uses for its major by-product/co-product: neem seed cake.

At the Indian Agricultural Research Institute, New Delhi, the neem cake is being investigated from the point of view of its use as a source of better manure and cattle food; a source of sulphur bearing amino acids and a source of pest control chemicals against certain pests of agriculture.

2. SHRI HARPAL SINGH (Gwalior).

As stated by Dr. Gulati, it is true to some extent that there is no material to be called as waste and specially molasses which is used in fermentation industry. However, on places where this material cannot be used for fermentation it can be very nicely utilized as a manure as suggested by Dr. N. R. Dhar of Allahabad. In using this material it is but necessary to take precaution that it should be used in the soil at least 3 months before sowing or at the time of irrigation. During our experiments on molasses irrigation it was found that it helps the sugarcane crop greatly with respect to yield and quality. The other beneficial way is to use it as a dilute solution for spraying and we found that by doing so there is an improvement in cane quality. For using it in fermentation industry or in Agriculture there is a problem for its transport and some experiments were done to solidify the molasses so that this problem may be solved, but this could be solved partially and further attempts are to be made in this direction.

3. SHRI S. C. MANDAL (Ranchi).

In the arable lands of Ranchi district a weed is extensively grown in the kharif season. This weed is the most dominant amongst all weedy vegetables in an arable upland in this district is kept fallow. The weed grows so vigorously that one feels tempted to find out if it has any economic use. The Agronomy and Animal Husbandry Departments of Ranchi Agricultural College have prepared a very good silage out of this weed. It can also be fed to cattle if mixed with other more palatable feeds. The milk production is not affected adversely when it is fed to cattle as a component of green feed mixture.

The discussion ended with a vote of thanks by the President given to the speakers.

I. INTERRELATION BETWEEN VITAMINS AND HORMONES

Section of Physiology

Chairman : DR. G. C. ESH (Calcutta).

CHAIRMAN'S INTRODUCTORY REMARKS :

One of today's most challenging problems in cellular physiology is how the several hormones may operate at the cellular level to produce the changes in metabolism in specific organs which are evident as changes in growth and activity. The endocrine control includes an adjustment of metabolism through the interaction of numerous hormonal activity in specific biochemical or biophysical areas to produce optimum substrate concentration, adequate enzyme activity and appropriate work performance in all organs and tissues in a variety of physiological and pathological states. Both the synthesis and degradation of hormones are dependent on enzymes and perhaps all the physiological effects of hormones are brought about by their regulation of specific enzymatic reactions within the cell. Since various vitamins particularly B vitamins are known to play great roles in these enzymatic reactions as part of enzymes or coenzymes a balance in the interactions of vitamins and hormones is likely to occur in maintaining the integrity and functioning of the body mechanism. Although the exact mechanism is not yet known both vitamin A and vitamin B₁₂ play a great role in the elaboration and function of thyroid and pituitary hormones. Vitamin B₆, pantothenic acid and ascorbic acid seem to be related to the secretion, elaboration and functioning of adrenocorticoid hormones and consequently of pituitary hormones. Present day studies indicate that even vitamin A whose mode of action in the body is not yet known seems to be related to the production of glucocorticoid hormones since vitamin A deficiency tends to lead to a degeneration of adrenal cortex cells and consequently to a depression in gluconeogenesis through an impaired production of glucocorticoid hormones. We have got many experts here and it is expected today's deliberation will be a fruitful one on such a vital problem in metabolism.

1. SACHCHIDANANDA BANERJEE (Bikaner) : *Interrelations of vitamin C-nutrition and insulin secretion.*

Vitamin C-deficiency produced in guinea pigs and rhesus monkeys by feeding a scorbutogenic diet was associated with imperfect carbohydrate metabolism. The scorbutic animals showed diminished glucose tolerance, diminished deposition of liver and muscle glycogen, decreased insulin content of the pancreas, degranulations of the beta cells of the islets of Langerhans, decreased hexokinase activity of the liver and muscle and decreased oxidation of citric acid in the tissues. All these changes can be attributed to the diminished secretion of insulin in the scorbutic animal. The changes observed in the scorbutic animals as described above could be reversed by the simultaneous injections of small doses of insulin from the tenth day of feeding the scorbutogenic diet. This further indicated that scurvy is associated with hypoinsulinism. It is, however, not clear how insulin formation is associated with normal vitamin C-nutrition. In the tissues of the scorbutic animals there is accumulation of dehydroascorbic acid which, however, is absent in the tissues of normal animals. Glutathione content of tissues is diminished in scurvy. Toxic substances accumulate in the tissues of scorbutic animals due to imperfect oxidation of phenylalanine and tyrosine. It is possible that sulfhydryl enzymes which are used for the detoxication of toxic substances produce an increased demand on glutathione. This tripeptide contains cysteine which is a part of the insulin molecule. The synthesis of insulin, therefore, is likely to be deficient due to the short supply of glutathione in scurvy.

2. A. SRIENIVASAN (Mysore) (*in absentia*) : *Vitamin B₁₂ and Experimental Thyrotoxicosis.*

The primary manifestation of thyrotoxicosis has been observed to be an impaired ability for retention of vitamin B₁₂ by the tissues. Thus, there is a pronounced decrease of the vitamin in liver and its mitochondrial fraction. A similar lowering of the vitamin in blood is accompanied by a loss of erythrocyte vitamin to the plasma. These observations are suggestive of '*in vivo*' osmotic damage to the structure of the cell and cellular particles. Such a damage to mitochondrial morphology is also evidenced by decreases in optical density, magnesium content and E₂₈₀ material in isolated mitochondria from thyrotoxic animals. There is a further lowering of rate of release of intramitochondrial nucleotides into surrounding medium. Impairment of mitochondrial function is also reflected in uncoupling of oxidative phosphorylation, failure of 2, 4 dinitrophenol (DNP) to afford protection against swelling and the significant lowering of the ratio of DNP to magnesium activated adenosine triphosphatase activity. Among the effects of thyrotoxicosis on other subcellular particles is the observed decrease in ribonucleic acid of ribosomes and this may be of importance in view of the recognised ribosomal function in protein synthesis. Other experiments have shown a decreased incorporation of formate-C¹⁴ into tissue proteins in the hyperthyroid rat.

The lowering of hepatic stores of vitamin B₁₂ interferes with the synthesis and utilisation of certain sulfhydryl enzymes. This has been studied both '*in vivo*' and '*in vitro*' with certain model conjugation systems, namely, the peptidation of the constituent amino acids of glutathione and the benzoylation of glycine. The results are indicative of a loss of efficiency in the funnelling of energy obtained from oxidative processes for biosynthetic pathways. Among other major alterations in sulfhydryl metabolism is the observed decrease in glutathione and concomitant increase in the coenzyme A contents of liver. A greater channelling of the sulfhydryl reserves of the cell into coenzyme A rather than into glutathione, possibly as a metabolic adaptation for increased energy production to offset the loss in efficiency of coupling of oxidation to phosphorylation in the thyrotoxic rat is indicated.

The enhancement of oxidative metabolism, as evidenced by increased succinoxidase activity of liver, in thyrotoxicosis, is attended by increases in cytochrome C, cytochrome oxidase and coenzyme Q, important members of the respiratory chain. The increase in coenzyme Q is particularly marked in the mitochondria. Evidence is available to indicate that the cytochromes increase at the expense of catalase, also a heme-protein, which registers a decline.

Vitamin B₁₂ supplementation exerts a significant protection against several of the metabolic derangements caused by thyrotoxicosis. It is possible that this protection might arise from the effect of the vitamin on the glutathione reserves of the cell, since the replenishment of liver stores of the vitamin closely followed by restoration of sulfhydryl reserves of the cell. Since evidence is available of the important role of glutathione in cellular integrity, the correction of several other derangements resulting from morphological damage, by vitamin B₁₂, appears to be indirect through its effect on glutathione. A protection, reflected only in a restoration of the changes in cytochromes and catalase and in mitochondrial swelling has also been observed with magnesium supplementation.

3. D. P. SADHU (Izatnagar) (*in absentia*) : *Vitamin A and Thyroid Interrelationship.*

It is well known that thyroid hormone helps the conversion of carotene into vitamin A and hypothyroid animals fed on carotene sources alone become blind due to nonconversion of carotene into vitamin A. Conversely vitamin A affects the thyroid.

gland. Heavy vitamin A ingestion depresses their basal metabolism and reduces thyroid weight. It also neutralises the increased metabolic effect of thyroxine injection. The decrease in thyroid size is produced by the lowering of the secretion of the TSH by the anterior pituitary. There is an increase in adrenal size also. Studies on reticuloendothelial system show that hypervitaminosis A causes decreased hepatic destruction of thyroxine, resulting in hyperthyroxinaemia; the latter reduces the TSH secretion and consequently the thyroid size.

4. R. CHANDA (Calcutta) (*in absentia*) : *Thyroid and antithyroid Drugs on the Metabolism of Carotene, Vitamin A and Tocopherol in Ruminant and Avian Species.*

Cow and Buffalo. The administration of L-thyroxine orally or parenterally increased the carotene and vitamin A ester content in the milk and blood serum of Haryana cows. Vitamin A ester content was also increased in the milk and blood serum of Murrah buffaloes treated with L-thyroxine. Vitamin A alcohol could not be detected in the milk of the buffaloes; a small but measurable amount (3 to 5% of the total vitamin A) of vitamin A alcohol occurred in cow milk. The proportion of vitamin A alcohol in cow milk increased significantly during noticeable hyperthyroidism caused by treatment of the cows with thyroxine when the ambient temperature was fairly high.

Buffalo digested dietary carotene better than the cow. The blood and milk vitamin A ester were related to dietary carotene, and the values were greater in the buffalo than in the cow at comparable carotene intakes on body weight basis. The digestibility of carotene increased in both the species during thyroxine treatment, the magnitude of the increase was more marked in the cow than in the buffalo. That the greater digestibility of carotene during thyroxine treatment was due to greater conversion into vitamin A was evident from the observation that measurable carotene could never be detected in the milk and blood of the buffaloes during thyroxine treatment period, whilst noticeable increases occurred in the vitamin A content.

Chicken. L-Thyroxine, aureomycin, vitamin B₁₂, and certain other drugs accelerated the intestinal conversion of β -carotene into vitamin A. The blood and liver levels of vitamin A ester and alcohol were also greater in the chickens treated with these drugs. Thiouracil, an antithyroid drug, inhibited the intestinal conversion of dietary carotene. Fractionation of the intestinal mucosa demonstrated that the increase in vitamin A produced by thyroxine treatment or decrease caused by thiouracil treatment occurred in the supernatant fraction of the tissue homogenate in which fraction the bulk of the vitamin A is normally present. In the liver, the increase in vitamin A caused by thyroxine treatment was located in the supernatant fraction and to a lesser extent in the nuclear fraction. The decrease due to thiouracil treatment was mainly in the nuclear fraction. Intestinal absorption of β -carotene as such was not affected in the chickens by the administration of the drugs.

The tocopherol content in the nuclear fraction of heart and liver tissues of chickens were decreased by thyroxine treatment. This was closely correlated with a simultaneous increase in the ubiquinone content of the tissue fractions. The effect was more pronounced when thyroxine treatment was superimposed on vitamin A deficient chickens.

5. S. LAHIRI (Calcutta) (*in absentia*) : *Hormones in ascorbic acid metabolism.*

All endocrine glands are known to contain high concentration of ascorbic acid. This high concentration has been thought to be related with the reported high

metabolic activity of the endocrine tissues but it has not been demonstrated whether there is a direct correlation between ascorbic acid concentration and oxygen consumption of a tissue. Nevertheless, ascorbic acid has been shown to be associated with the activity of the pituitary, adrenal cortex and islets of Langerhans—some endocrine tissues. Amongst all these pituitary produces the most dramatic effect on ascorbic acid metabolism in the adrenals of certain species. However, the meaning of this association is not known. In a search for the nature of the relationship, the fate of ascorbic acid which disappears from the adrenals on adrenocorticotrophin administration was looked for. Most of the ascorbic acid lost by the rat adrenals appears in the adrenal venous effluent as reduced ascorbic acid. Besides this, it has also come to light that other tissues, liver in particular, release a greater amount of ascorbic acid into the blood under the same condition which raises blood concentration of ascorbic acid significantly. New data will also be presented to show the profound effect of pituitary hormone(s) on another aspect of ascorbic acid metabolism in various tissues of rat.

Teleologically, ascorbic acid seems to go well with hormones: ascorbic acid is dispensable as a vitamin where hormones do not function normally, such as, in primitive metabolic machinery. Ascorbic acid is the only vitamin known to have direct hormonal influence on its metabolism.

6. CHANDICHARAN DEB (Calcutta): *Effect of Ascorbic Acid Deficiency on the Histochemical Changes in Testes.*

Various histochemical tests were applied on the testes of normal and ascorbic acid deficient guinea pigs with an idea to assess their activity. The more prominent changes observed are as follows.

During ascorbic acid deficiency there was a rise in sudan positive materials in the interstitial cells. These materials responded to histochemical testes for cholesterol. There was also a rise in plasmalogen, which indicated ketosteroids, and an enzyme acid phosphatase in these cells during scurvy. The above changes observed possibly indicated a non-functional accumulation in ascorbic acid deficiency. A reduction in spermatogenesis has been observed under similar condition. There was a marked fall in the number of mature spermatocytes and spermatids. This decreased spermatogenesis caused a fall in the activity of succinic dehydrogenase, both acid and alkaline phosphatases and D.N.A. Changes have also been observed in the tunica albuginea of testes and glycoprotein containing cells of anterior pituitary in the scorbutic guineapigs. Effect of gonadotrophic hormone treatment on the observed changes has also been studied.

7. N. K. ROY (Calcutta) (*in absentia*): *Influence of vitamin B complex on the maintenance of estrus cycle in mice and rats.*

The role played by vitamin B complex in the intermediary metabolism of carbohydrates, fats and proteins is well known. Their influence on the synthesis and function of various hormones through enzymatic pathways is being worked in recent years. The part played by them in the regulation of estrus cycle seems to be of considerable interest. It has been observed in our laboratory that our inbred laboratory white mice and rats complete one estrus cycle in 5 or 6 days. Peak-estrus showing about 95% of cornified epithelial cells in vaginal smear with almost complete absence of Leucocytes never last for more than 2-3 hours. In mice and rats kept on vitamin B poor diet, it has however been observed after repeated experiments that the estrus state continues for days, obliterating the post-estrus, diestrus and proestrus phases. These animals fail to conceive in almost cent per cent of cases compared with control animals on normal diet. Even in spayed

animals on vitamin B deficient diet estrogen stimulation by injection produces same change in the vaginal smear which is much more prolonged than spayed controls on normal diet. The same animals on restoration to normal diet or on administration of B complex cease to exhibit such phenomenon and again conceive in usual time. Whether this phenomenon is a direct result of vitamin B deficiency on estrogen or indirectly caused by damages in the liver which is responsible mainly for inactivation of estrogen is under investigation.

8. S. C. JAMDAR and S. MOOKERJEE (Calcutta) (*in absentia*): *Adrenocortical function in Riboflavin-deficient Rats.*

In riboflavin-deficient rats there was a tendency for liver to assume a greater proportion of body weight. But other organs, such as testis, spleen and thymus did not show any significant change in weights when changes in the weight control groups were also considered. Adrenal weights and their cholesterol and ascorbic acid contents were not affected ascribable to riboflavin deficiency alone.

On 16% casein diet liver catalase activity is greatly reduced but was restored towards normal by feeding 40% casein diet in riboflavin-deficient rats.

Lymphocytes show a distinctly lower percentage in riboflavin-deficiency among white blood cells.

From these findings a possible effect of riboflavin deficiency upon adrenocortical function will be discussed.

II. GROWTH AND NUTRITION

Jointly with the Sections of Anthropology and Archaeology and
Medical & Veterinary Sciences)

Chairman : DR. G. C. HSH (Calcutta).

CHAIRMAN'S INTRODUCTORY REMARKS :

Anthropology is concerned with the development of man and his behaviour; nutrition is involved in understanding the specific relationship of man and his behaviour and the environment that nourishes him. The history of man has been one of continuing adjustments to different environments and the diet is one of the most important factors in these adjustments of the organism to an environment. The anthropologists and nutritionists can therefore, benefit from mutual consideration of the behaviour of man. The nutritionists turn to the anthropologists to find better ways to institute changes of food habits in population segments manifesting dietary deficiency diseases. The anthropologists' functional and wholistic approach is of particular utility in trying to find ways to change dietary habits. The nutritionist who clearly identifies certain psychological characteristics with nutritional conditions such as dullness of kwashiorkor in children provides the anthropologist with insights into the culture of the people he is trying to understand. Thus both at the understanding what food man really needs and understanding how to help man get the food he does need there is a broad and productive future for the collaborative efforts of anthropology and nutrition.

Food habits are thoroughly immersed in culture and they affect food intake as importantly as do the soil, the climate and agricultural development. Food-directed behaviour involves much more than the physiological need. It includes appetite, sharpening of brain, aesthetic enjoyments and longevity of life. The crucial problem today is the development and popular acceptance of a diet con-

ductive to maximal health and vigorous longevity and in this task collaborative efforts from nutritionists, anthropologists and medical men are extremely necessary.

1. P. N. SENGUPTA (Calcutta) : *Nutrients Usages and Growth of the children of different Tribes of India.*

It has been demonstrated that improved nutrition definitely increases the rate of growth of a population group. Due to improved nutrition the boys in U.S.A. were 8% taller and 12% heavier in 1941 than the boys 50 years before. The role of nutrition in 'Chemical Growth' has been extensively studied from infancy to adolescent stage and such studies included intellectual and psychological aspects, character, alertness and physical fitness. The growth and development signify, in broader sense, the increase in stature and weight corresponding to ages from 5 years to 14 or 15 years age. It is also known that nutritional qualities of the dietaries have profound effects on the growths in weight and stature.

In the nutritional investigations undertaken among many tribes living in different parts of India, the diets of random selected families in each village were surveyed, their nutritive values determined and the average intake of calories, protein and ten nutrients were assessed. For the present discussion, intake of calories and protein have only been considered to determine their effects on their growths. The children of each tribe, of 5 to 15 years age groups, were measured for stature and weight and vital capacity etc. The overall increases in stature and weight from 5 to 14 years age have been taken as their growths. 15 tribes had been studied, of which 4 were of NEFA, 3 of Tripura, 2 of Bihar, 2 of M.P. and 4 were of Kerala.

Maximum growth in weight were recorded in the children of Galong tribe of Abor hills, NEFA, and of Riangs of Tripura who had comparatively most satisfactory diets and lowest percentages of families deficient in the intake of calories and protein. Minimum growths had been found in the Nocte tribe of NEFA and in the Travancore tribes who had lowest intake of calories and protein and as high as 87 to 93 per cent families were deficient in the intake of calories and protein. Further results showed that two groups of the same 'Minyong' tribe of Abor Hills living in two settlements, Balek and Ledum, 20 miles apart, had different rates of growth in weight due to the fact that Balek group had better nutrients usages due to improved cultivation than Ledum although both the groups were of same racial heredity and had marriage relationship. Furthermore, the same families of Santals of Santal Parganas and Ho tribe of Singhbhum, Bihar, were surveyed in 1940 and again in 1952, 12 years later. Both the tribes in 1952 had increased intake of calories and protein by about 800-900 calories and about 20 gms. respectively. In both of these tribes the stature and weight of the boys had increased by about 1.5 inches and 2.5 to 3 pounds respectively. These investigations proved beyond doubt that even the tribals, who did not generally buy foods from the markets, had growths according to the nutrient contents of their dietaries and also the tribal groups of the same racial heredity had growths of their children differently according to the differences in their intake of nutrients.

2. KALYAN BAGCHI (Calcutta) (*in absentia*) : *Nutrition and the growth of the eye-ball.*

Proper growth of the eye-ball, with its different component parts is essential for correct vision. It is believed that being a vital organ, its growth as a whole is to a large extent independent of nutrition supply. The growth of the different component parts of the eye-ball, in relation to each other, is of much greater

importance in the functional aspects of the eyes. Recent investigations with human eyes suggest that the growth of the cornea, lens and the retina and the refractive indices of mainly the cornea and the lens control the refractive power of the eyes. Chemical composition of the cornea and the lens might also influence their refractive indices. Thus, nutrition, by affecting the growth of the component parts and in the refractive indices of some of them might play an important part in controlling the refractive power of the eyes.

Refractive power aberrations especially in the form of myopia has been described recently as correlated with protein deficiency. Myopic process has been halted with animal protein supplementation of the diet. The incidence of myopia was found to be extremely high in student population, in whom the general standard of health and nutrition was found to be extremely poor.

Experiments were conducted on albino rats of Glaxo strain and rabbits on a protein deficient diet and the different components of the eye-ball were examined. The following findings were found to be of importance :

(A) histological and histochemical examination of the cornea revealed that the stroma of the cornea is distorted in architecture followed by hydration—an important factor in disturbing the normal refractive index of the cornea.

(B) altered structure of the cornea will disturb the power of the cornea to adapt its curvature to suit the growing eye-ball.

(C) protein malnutrition produces changes in the sulphhydryl distribution in the lens, its amount in the cortex in the lens is significantly reduced and the lens nucleus accumulating a large amount of disulphide groups. Actual measurement of the refractive index of the lens by Abbe's refractometer using bovine albumin showed a rise.

(D) gross alteration in the histological structure of the retina suggesting its inability to act as a co-ordinator of the different components of the eye-ball.

The above evidences indicate that in case such changes occur in the human eye as a result of protein malnutrition, refractive error in the form of myopia will set in.

3. KAMALA SOHONIE, K. V. PANSE and S. H. MAHISHI (Bombay) (*in absentia*) : *Effect of Neera on the Growth of School Children.*

Neera is a good source of minerals and vitamins. Work regarding nutritive value of Neera on animals was done before. It is therefore, thought of interest to study the effect of Neera on the growth of school children. One hundred and eight children residing in three different hostels were selected for the experiment. They were divided into two homogeneous groups. Experimental group was given one glass of Neera while control group was given one glass of sugar solution. Weight, height and haemoglobin were recorded before and after the experiment. The difference in weight between the experiment and control varied from 0.2 to 1.4 lbs. The difference was statistically significant in the case of one hostel. The difference in height ranged from 0.4 to 1.3 inches and it was statistically not significant. As regards haemoglobin the difference was from 6.2 to 9.12% and it was statistically significant in the case of two hostels.

4. B. S. KAUSHAL, D. N. MULLICK and N. D. KIRHAR (Izatnagar) (*in absentia*) : *Effect of different zonal feeds on the rate of growth of Bengal and Haryana calves.*

16 calves of 9 to 11 months old of dry hot zone (Haryana breed) and humid hot zone (Bengal breed) were divided into 2 groups. One group of both the breeds was fed with Punjab diet and another group with Bengal diet. All the feeds of

Punjab diet were brought from Hissar, Punjab at regular intervals and for Bengal diet they were procured locally. The diets were made balanced and isocaloric. They were adequately fortified with trace mineral mixture and synthetic vitamin A. Body weights were recorded weekly for 100 weeks. Anthelmintic drug was administered at regular interval. The experimental station was at Calcutta.

The average four weekly rate of growth are as follows :

| | | | |
|--------------------------------|-----|-----|------------|
| Haryana heifers on Punjab diet | ... | ... | 17.98 lbs. |
| Haryana heifers on Bengal diet | ... | ... | 17.81 „ |
| Bengal heifers on Punjab diet | ... | ... | 11.32 „ |
| Bengal heifers on Bengal diet | ... | ... | 10.58 „ |

Critical examinations of the results indicated that the groups on Punjab diet in each breed had higher rates, but statistical calculations of the data according to analysis of variance showed that 'F' ratios between the dietary groups within each breed turned out to be insignificant.

From the present observation, it may be concluded that if the feeding conditions are adequate and diseases especially of parasitic origin are controlled, the humid tropical conditions do not adversely influence either the growth rate pattern of imported calves from dry tropical zone or local stock.

5. SUJATA CHAUDHURI (Calcutta) : *Statistical analysis of data of height, weight and Haematological Values of new born babies in Punjab and in Bengal.*

It is generally believed that normal new born babies of Punjab are healthier than that of Bengal. A statistical analysis of data of height, weight and of Haematological values—Haemoglobin and Red blood cell count, on new born babies in Punjab and Bengal is done.

It is found that mean height and weight of Punjab babies are not significantly greater than those of Bengal babies, the same applies also to the Haematological values, from t-test results.

No significant difference detected from this sample between males and females with respect to each of the above characteristics both in Punjab and Bengal as per table III. There is no significant difference between Punjab and Bengal as regards these characters as per table IV.

III. STRUCTURE AND FUNCTION OF SYNAPSES

Chairman : DR. G. C. BISH (Calcutta)

PROF. STEPHEN, W. KUFFLER (Harvard University)—Spoke about the general physiology behind the structure and function of neuro-neuronal and myoneuronal junction. He elucidated the biochemical and bio-electrical phenomenon e.g. the role of chemical mediators, acetylcholine, adrenaline or noradrenaline and the importance of synaptic and end plate potential in the mechanism of transmission of nerve impulses along these regions.

PROF. E. DeROBERTIS (Argentina)—Ultramicroscopic structure of the synaptic regions were demonstrated by Prof. DeRobertis with the help of some fine slides. His electro microscopic observations revealed that probably there is some sort of structural continuity between an axo-dendritic or synaptic junction. His electron microscopic studies, specially in relation to suprarenal gland, pineal body, hypothalamus and hypophysis emphasized the importance of neuro-endocrine hypothesis.

PROF. W. D. M. PATON (Oxford University)—Spoke on the mechanism of action of drugs acting on the synaptic region. He explained the mode of such therapeutic agents on the basis of receptor theory. He also placed that the mechanism of competitive or non-competitive action of these drugs on the receptors of the effector organ may be compared with the mechanism of enzyme action. His approach to the mechanism of action of such pharmacological agents on the basis of enzyme kinetics applying the Michaelis Menten equation is of much interest.

The Chairman summarised the salient features of the papers presented and invited discussion from the members present. Dr. Ghosh, Dr. Krishnamurti, Dr. Kar, Dr. Sen and others participated in the discussion.

I. NATURE OF PERSONALITY

Section of Psychology & Educational Sciences

Chairman : DR. G. D. BOAZ, Madras.

Dr. E. I. George opened the discussion. Among other thing he emphasised on the application of factor analysis.

1. E. I. GEORGE (Kerala) : *The Nature of Personality—A Dimentional Approach.*

The necessity for a scientific study of personality is indicated. In personality we study the individual in totto. Existing theories have been classified into two viz. dynamic and static. The view that static theories should precede dynamic ones is stated. It is held that attempts for taxonomy is a desideratum in the field of personality. The Eysenckian theory of personality is discussed and an appeal is made to adopt factor analysis as the method for categorization in personality.

The essential application of factor analysis in the new branch of research in psychology naniely Psychopharmacology is advocated. Finally the successful employment of the dimensional approach to study intellectual abilities and problem solving behaviour. Cognitive abnormality, Heredity and Psychological abnormality, constitutional factors and abnormal behaviour are mentioned.

2. M. S. PRASAD :

The present concept of personality in the light of modern psychology does not explain all the human peculiarities but yoga psychology seeks to explain them. So this yoga psychology should be studied according to modern research techniques. Fortunately such attempt has been made by the Research Centre of Creative Altruism of Harvard University. The yogic concept of human personality should make a contact with the above said University and take some steps which will be helpful in India.

3. DR. D. GANGULI :

In my opinion the attempt of Dr. E. I. George was to emphasize on the methods of assessing personality aspects under different dimensions whereas Mr. I. B. Sachdev was that of yogic methods on the influence it makes, in changing personality by knowing his present self and having an idea of desired personality pattern. So, I think that two papers deal with two different aspects of knowing and understanding personality.

II. PROBLEM OF STUDENT UNREST

Chairman : DR. G. D. BOAZ, Madras.

1. DR. SRI CHANDRA (Lucknow) :

Student unrest is universal but the form it takes in Indian Universities is diversified and a matter of degree. The ill behaviour of student is only a project of the same in the teacher or other elders and companions in the society.

Students' unrest is due to many factors but in certain cases students come to the University to enjoy life—not to study.

Human and Psychological approach to the problem would be more rewarding.

2. B. C. KAR (Cuttack) :

Students are over indulged by the authorities. Political parties control students' unions and hence indiscipline. Students should be engaged in active pursuits besides studies. Teaching aptitude in teachers is important.

3. R. C. DAS (Cuttack) :

Student's personal work would reduce student unrest. This would remove frustrations from students which they may carry from home.

4. PRIYARANJAN MOHAPATRA (Cuttack) :

Adjustment of students to the fast changing conditions should be brought about. Aspiration and achievement should not have a big gap.

5. Dr. S. Sinha (Calcutta), read a paper in which he stressed the need for a thorough probe into the matter both from the University as well as from various other sources.

Sri Asit Nath Deb (Delhi) and Dr. K. N. Sharma (Calcutta) laid emphasis on certain aspects of examination system.

Dr. R. G. Chatterjee (Calcutta) said that an opinion survey showed that unrest may be attributed to : (a) favourable family condition, (b) effect of various movements organised by different political parties, (c) insufficient preparation for the examination etc. The speaker laid more emphasis on further study and report.

The yogic system more or less takes the position vis-a-vis those taken by neuropsychology or that of psycho-pharmacology.

SCIENCE, FREEDOM AND HUMAN PROGRESS**Section of Science and Its Social Relations**

Chairman : DR. B. MUKERJEE, Lucknow.

1. U. P. BASU (Calcutta) : *Science, Freedom and Progress : Need of Co-ordination and Planning.*

Science is the process that men of all nations have evolved in their search for truth. In doing so the followers of this discipline have worked out methods by which people can live in peace and contentment. With urbanisation the concept of values of life has, however, undergone a change and the voluntary co-operative communism in which the majority of the people in a country worked together for the good of their community has disappeared.

In any progress for meeting the needs, requirements, health and pleasure, scientists and technologists are now playing a greater role. In such an endeavour their movements, will, or freedom should not be shackled, as otherwise the best cannot come out of their efforts. How one will look upon another is, of course, a matter of every man's own conscience, but the best intellect, initiative, and drive would come from a man when he is free to work for himself and for his comrades in the society in which he lives.

The utility of science for the benefit of mankind is revealed through the work of the scientists, but their creative ability will be fully manifested if there be opportunity for work in an organised and co-operative way whether in the field of education, research, industry or administration. Success in scientific achievements needs co-ordination and planning. The well-known physicist engineer of the U.S.S.R., Prof. P. L. Kapitza, recently remarked that the success of science in the Soviet Union, is due mainly to the mobilization of the means and the scientists, and to the concentration of their ideas on an important task. It is to be remembered that creativeness of the individual is at the root of any human progress, but the individual should not deviate from the vision that the ultimate success in creation of his own society and nation lies in group action.

Science is the modern instrument that is helpful in enhancing the prestige and prosperity of a nation. The scientists must, however, see that it is not abused, or, exploited for industrial, military or political purposes in the greater interest of mankind as a whole.

2. PRIYADARANJAN RAY (Calcutta) : *Science, Freedom and Human Progress.*

Science, with truth as its objective and with its dislike for untested faith, has eliminated many social evils and heralded a new era of reason and free thinking. But offering a mechanical explanation of nature it has at the same time given rise to a materialistic philosophy of life. Matter and motion are regarded as the only really real elements of reality. It denies freedom to human will and action, giving prominence to the law of causality as a universal principle. Moral values are discarded except for utilitarian purposes. Pleasures and enjoyments are viewed as the sole purpose of life, leading to an unbridled lust for power and possession with its attendant evils of widespread strife and suffering. The physical and psychological enslavement of man and a cold war with its dire threat of his annihilation by a nuclear warfare have been the outcome. The spectacular and almost miraculous triumphs of technology have merely provided a tower of strength to this materialistic philosophy of life.

The enormous and unlimited power, furnished by science and technology, is wielded only by a few in the society—the capitalist or the ruling minority. They are armed not only with the power of coercion (military and police), but also with that of persuasion (newspaper, radio and cinema). The masses are thus deprived of all their freedom, and submit to the dictates of their rulers for the sake of their subsistence and security.

The progress of technology through its labour-saving devices has led to unemployment with consequent social and economic insecurity. The growth of industrial cities and towns with congested quarters and artificial ways of life for the workers offering no creative interest in their work, serves nearly to complete the process of physical, psychological and moral enslavement of the people.

The spirit of nationalism has been instrumental in further intensifying the process of mass enslavement and in giving rise to power-blocks and armament race on a colossal scale. The enormous amount of money and resources are thus being wasted for the production of, and researches on, war materials and war

weapons. Scientific materialism coupled with nationalistic sentiments has thus given rise to a new type of irrationality and illusion.

The primary need of humanity and the real problem of the world today is the production of sufficient food for all. The first and the foremost concern for the common man is his next meal. The masses have little interest in national or international power policies. But the ruling powers will not leave them in peace and in the name of safeguarding their welfare and interest do not hesitate in adopting policies and measures spelling ruin and disaster for them.

The need for a new outlook in science can, therefore, be hardly emphasized.

3. K. RAY CHOWDHURY (Aligarh) : *Science, Freedom and Human Progress.*

The topic is extremely complicated, and unless a speaker starts with a base, his talk would be meaningless and invite criticism from all corners. It is desirable that we should first define the terms, Science, Freedom and Human Progress. We would agree on the point that Science is systematic knowledge derived from empirical methods. Also, it is hoped, we would agree to the extent that the horizon of our ignorance is gradually vanishing because of our continual process of discovering facts and enriching the storehouse of science. Science in return opens our eyes and gives freedom to move in a direction that we had never thought of in the past. Therefore, the base of freedom is creation or discovery and not time and space which can be shown, from the philosophical angle, as always varying and not remaining constant.

Now the question arises as to which particular branch of science, the present speaker would like to pick up as his base of the above statements. Of course, it is psychology. And since the present occasion gives a speaker the liberty to show off a little, the present speaker would submit some new discoveries done by him and his two disciples, namely, Dr. Raj K. Ojha and Dr. Aquil Ahmad who recently received Doctorate Degrees working on two topics under the supervision of the present speaker.

The present speaker and Dr. Raj K. Ojha in 1957, 1960 worked on "Intelligence and Intellectual Stimulation during Adolescence" and verified the claims of Professor P. E. Vernon (1957) that intelligence could not be described as "hereditary" since we have no instrument to measure it. Therefore, whatever planning we may have in connection with the educational systems to nurture the young adolescents, we must not forget the freedom we have out of the knowledge derived from empirical studies on the issue. We can therefore train our children and develop their ability factors according to our bigger national plan if we have any.

Dr. Aquil Ahmad and the present speaker in 1957-1960 worked on "Factors in Attitude Formation towards Democracy" and empirically verified the claims of the present speaker (also cf. Ray-Chowdhury, K., *Modern Review*, October, 1952) that "Gandhian Personality" would help us study both the problems of personality and those of attitude in psychology in a much better way than Adorno's (1950) Authoritarian Personality Approach in the field since the new concepts of non-violence and violence described by Gandhi (Cf. Bose, N. K., 1947, *Studies in Gandhism*; Dhawan, G., 1951, *Political Philosophy of Mahatma Gandhi*) are neither found in the Psychological literature manufactured in the West nor are they actually understood by the Western psychologists because of the lack of skill on the part of those who understand the terms, to discuss the issue through the western methodology. The present speaker therefore constructed a scale, jointly with his above disciple with the scaling principle as laid down by Allport and Vernon (1951) in their Study of Values, on "Attitude of Non-violent Non-cooperation Towards (Gandhian) Democracy" using the concept of "just selfishness"

as the base of Gandhi's Democracy and choosing items according to Gandhi's concept of "violence and non-violence of the coward" under "violent co-operation and violent non-co-operation" categories on the one hand, and that of his "violence and non-violence of the brave" under "non-violent co-operation and non-violent non-co-operation" categories on the other. In the process of the above research it was possible to measure the degree of identifiability of "non-violent non-co-operation" and "non-violent co-operation" with Adorno's (1950) "authoritarian aggression" and "authoritarian submission" respectively. The above research, the present speaker believes, opens the eyes of Western psychologists and Indian thinkers to the extent that there was so far a lack of our understanding on a vital point regarding the nature of Gandhian non-violent non-co-operation which could be used both as a trait in personality measurement and as a wonderful strategy in warfare. If we are satisfied on the issue, the speaker thinks we shall have freedom to solve our differences and press more scientifically the issue on disarmament. So, how could we say that science does not give us freedom to have human progress?

4. NILAKANTHA ACHARYA (Cuttack) : *The limitations of science for human welfare.*

"Science is a progression of tested propositions leading to general laws and applied to scientific problems or as a continuing adventure of the human mind in which the challenge of the unknown is matched by the creative spirit of the man, a constructive stirring of minds to find order, unity and intelligibility in natural phenomena and events which to the untutored mind appear haphazard or capricious."

The ardent zeal and devotion in scientific men for the quest of the truth of science is itself a sufficient testimony that it must meet one of the deepest needs of human nature namely the desire for beauty. It is in this aesthetic aspect that the chief charm of science resides. To the majority of laymen, science is valuable chiefly for its practical application. But to all the greatest men of science practical applications have emerged incidentally as a sort of by-product. To the great man of science, science is an art and he himself is an artist. His work is not the less a work of art because it is but a faint and imperfect copy of another—of the supreme work of art which is nature itself.

The 20th century has witnessed a remarkable progress in the field of scientific discoveries. Although many epoch-making discoveries have been made in the past, their application for practical purposes and rapid development of the associated sciences has become a phenomenon of the 20th century. So science has served humanity and made the way for its progress most in the present age, rather than in the past. Perhaps in no fields of science could the constructive use of scientific discoveries be more clearly demonstrated than in the field of medical sciences. For example, many important drugs have been found out that are capable of destroying some of the most harmful bacteria which took a heavy toll of life before. The relations of science to society have been full of promise. In this age scientific achievements have been outstanding and full of promise for the greater possibilities of human welfare than ever before. Let us hope that there will be future Newtons, Faradays and Ramanujams to provide new insight into the eternal mystery of the universe.

The social need of the present day requires scientific planning so that individual scientists may be guided to the more urgent needs of society. It saves the time lag with the saving of millions of human lives or increasing the welfare of mankind at large. In fact a better system of scientific education should be

adopted to a society consciously aimed at securing the maximum human welfare. Science knows no frontiers. This has been well manifested by many international scientific organizations. For example, the International Geophysical Year is a period of an organization undertaken in collaboration with as many as about seventy nations of the world. But also many disciplines of science have their part to play in making observations during this period, leading to the discovery of the secrets and mysteries of the planet on which we dwell. Therefore the approach seems to be a happy movement towards the universality of science from all points of view.

But unfortunately the danger is of giving science too much credit. Now that the problem is rather that of finding the means by which science can be directed to constructive and not to destructive ends so that it can serve for human progress rather than for the total annihilation. Knowledge as such can never provide a moral mode of living, nor insure salvation for mankind. Today science has failed to control tyranny and brutality. It is primarily because the modern age has overestimated the power of secular and material knowledge to influence the conduct of human beings. We have interpreted science wrongly by expecting it to serve a purpose which is not in its domain—the creation of an ideal society.

"The complete divorcement between scientific research and spiritual and moral ideas has brought disastrous consequences. A science which remains indifferent to the importance of morality in the life of society becomes an opponent of morality. The end of learning should be the cultivation of intellectual and spiritual values bringing to a maximum development the moral potentialities of man."

However it must be admitted that science is for its own sake. That is some work on science with passionate zeal to explore and study for study's sake only without any motive or implication of its application for human welfare. So much cannot be expected from science for the benefit of the mankind at every stage.

Also some fundamental changes in the social structure in mankind is necessary to bring about any radical progress in science.

5. NIRMAL KUMAR BOSE (Calcutta) : *Science, Freedom and Human Progress. The Progress of Science*

Science has raised the power of mankind to almost unprecedented levels. Atomic power has not yet become an economic proposition; but there is no reason why it should not be one in the near future. The sun's rays may one day yield up their resistance, and be converted into cheap electricity for human use.

Metals which were once rare, are now more easily available. New alloys have been produced to serve many new purposes. It appears that plastics will take the place of several raw materials which are now considered indispensable.

Microscopes and calculating machines have been improved to an extent undreamt of in the past. These have lightened the scientist's work, and made work faster and more accurate.

Comparable advances have taken place in chemistry; so that the distinction between the living and non-living has been progressively reduced. We are perhaps on the threshold of an era when life-processes will yield up their secrets, and a control over them will be exercised by man in a manner which is comparable to that exercised over inert matter.

Conspicuous advances have also been made in the field of psychology. Freud's investigations have opened up a new way of understanding the human mind. Numerous observations are being made in many laboratories of the world on individual and collective behaviour. And, although the progress made so far has been

small in comparison with achievements in the physical sciences, or even in biology, yet it has not been altogether negligible. At least, researches in human behaviour and methods of communication have armed leaders of various communities with powerful weapons by means of which they can mould men's opinions or actions towards particular ends.

Progress has undoubtedly taken place in numerous directions. Man has gained a sufficiently deep understanding of nature's processes to enable him to secure a fuller satisfaction of his bodily needs.

The Social State

But power thus gained through the services of science is not evenly distributed. Both scientific knowledge and its application in the world are in short supply. Or perhaps the economic and administrative machinery by means of which these benefits can be utilized for the enrichment of human life as a whole, has till now proved to be inadequate for the purpose. Particular nations, or small groups of privileged persons within a nation tend to keep within their dispensation the benefits which accrue from science.

Power derived from scientific advance does not also necessarily come to a nation or community which is endowed with moral worth, and become denied to another of the opposite kind. It seems to accumulate without reference to the social ideals to which a nation may chance to subscribe.

As a result of all this, there is a scramble for power; and the character of war has also become completely transformed. No boundary is today able to secure immunity to a nation from destruction. In addition, that destruction involves, not combat forces alone, but the whole population of a country which is situated in strategically significant neighbourhoods.

War has also become so expensive and complicated in organization that small nations cannot hope to prepare adequate defence by means of their unaided strength. They have to tow the line with one or another power block.

A hope has occasionally been expressed that the fear of atomic destruction will restrain the hands of those who wish to involve mankind in war. This is perhaps an idle hope. Perhaps hundred-megaton bombs will not be used in actual combat, but will only be blasted for yielding rich political harvests. Wars of attrition will still be carried on, while nations will continue to arm themselves with atomic weapons in order to maintain a rather precarious balance of power in their own favour. Today every block tries to remain at the top; but as two cannot occupy the same superior position at the same moment of time, this race for destructive weapons and defensive apparatuses will continue to consume a larger proportion of man's total output of energy than ever in the past.

Moreover, this continuous war of attrition in which the modern world seems to have become involved, has tended to maintain men in a state of anxiety, and constant psychological preparedness for an armed conflict.

Some social philosophers have expressed the view that the present sufferings of mankind in the midst of a promise of plenty is on account of the fact that development in the art of social integration have not been able to keep pace with development in the technological sphere.

Freedom attained so far

Science has furnished mankind with a promise of freedom from want and fear of disease and early death. This has indeed been a superb achievement.

But the freedom to pursue one's aims in the arts or sciences, or in social living are not today available to all members of the human family in an equal measure. Indeed, it lies within the reach of only a small fraction. Hence the envy and

hatred, on the one hand, and the anxiety and fear which seem to have infected men's minds on the other is likely to undo many of the gains which have otherwise been registered.

The nature of the freedom achieved has been, in addition, of a limited character. Thus there is security from the threat of want and the ravages of disease. In certain fields, again, a release has been achieved from the fear of social restraint or of compulsion. Such freedoms, being of a negative character, do not by themselves create the best conditions of human growth. A more positive content of freedom is needed before the best in human nature can spring forth under its magic influence.

Another Meaning of Freedom

A garden proves best when individual plants and their flowers turn out to be best. Similarly, a social organisation has to prove its worth by the excellence attainable by individuals living within its compass. If such excellence is open to a small proportion, then the organisation is considered to be inferior to another in which the same opportunity is offered to many without restriction.

When the weeds which choke the growth of a plant are destroyed, and the plant left free to grow as best it can on its own account, that alone may not constitute the optimum condition for the promotion of excellence. Perhaps the growth of a plant may also be hampered by internal as much as by external conditions. After attending to external conditions, and getting rid of them, the need may arise of attending to the remaining conditions so that excellence may be positively promoted from within. Perhaps the distinctness drawn here between external and internal is less than we imagine; yet in the present state of our knowledge the difference cannot be wholly ignored.

Some of the great teachers of mankind have said that the attainment of freedom, and of excellence, depends more on internal than on external circumstances. The latter are necessary, but the critical conditions lie within. In the words of such teachers, freedom means a liberation from inner bondages, from likes and dislikes, so that the truth of a specific situation, or even of a larger kind, like the relations between man and man and between man and nature, may shine clear before him with the utmost clarity. This inward freedom has been cherished by many a great teacher; and those who have left any record of experiences have borne testimony to the fact that the mind is then not only raised by the realization of truth, whether particular or abstract, but the whole being is then steeped in a kind of joy which is not attainable by any other means.

An inward joy of the same nature has also been experienced by some of the greatest men of science. And there is no reason why its attainment may not be converted into a possible experience for larger numbers of mankind. Indeed, the methods of science have already brought to the doors of many, the possibility of attainment of objective truth. Formerly, that lay within the reach of only a privileged few. Science has democratized the search for truth. Why should it not be able to democratize the attainment of an inner joy which springs from freedom achieved?

When sciences like psychology or anthropology are pursued in the proper spirit, they help us to see ourselves as in a mirror. Then, petty attachments to particular values can be viewed in a new perspective, and one's mind becomes progressively freed from what has been symbolically denoted as 'bondage' in the religious literature of the world.

Without in any way trying to belittle the importance of science's achievements, in fact even while welcoming all that has been done to relieve mankind of fears of a hundred kinds, may we not hope that its services will now be turned in the

direction of the attainment of a new freedom : freedom from the bondage of fear of our fellowmen, of the communities which they have built up for the incorporation of new systems of values, and which each tries to preserve by raising round it high walls of self-interest ?

Perhaps it will be in this field that further conquests of science will be scored in the future.

In the past, there have always been a handful of individuals who have attained the highest measure of inward freedom. Perhaps, in our age, science will be able to show the way to its large-scale attainment. As the human family grows in number, and as inter-human relations become woven into a more complex network, the benefits of freedom in both the physical as well as mental spheres should be shared in common, or at least made available in an equality of opportunity to all without discrimination.

APPENDIX

LIST OF MEMBERS

HONORARY MEMBERS

Beaufort, L. F., D.Sc., de Hooze Kley, Amersfoot, Netherlands.

Hill, A. V., F.R.S., 16, Bishop Road, Highgate, London 6.

Nehru, Jawaharlal, Prime Minister of India, New Delhi.

**Raman, Sir C. V., Kt., F.R.S., Nobel Laureate, Raman Research Institute, Hebbal,
Bangalore.**

Visvesvaraya, Sir M., K.C.I.E., 5, Cubban Road, Bangalore.

BENEFACTORS

Burmah Oil Co. (India) Ltd., Digboi, Upper Assam.

**Ghadially, Pestonji, F., B.Sc. (Engg.), F.R.G.S., F.R.S.A., F.B.H.I. (Lond.),
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N. N. Wadia Charities, 22-D, Parsi Bazar Street, Fort, Bombay-1.

Tata Iron & Steel Co., Ltd., Bombay House, Bruce Street, Fort, Bombay.

MEMBERS (WITH VOTING RIGHT)

(The names of Life Members are marked with *)

A

- A. B. M. Industries Corporation, 1/1, Badan Roy Lane, Howrah.
 Abraham, A., Head of the Department of Botany, University College, Trivandrum.
 Abraham, (Miss) C. D., Nandyal R. S. Post, Kurnool Dist., Andhra.
 Abraham, P., 15/187, Sion East, Bombay-22.
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 Aditya, Sukumar, Ph.D. (Utkal), Reader in Physical Chemistry, Department of Applied Chemistry, 92, Acharya Prafulla Chandra Road, Calcutta-9.

- Advani, R. M., B.E., M.I.E.,** Professor of Civil Engineering, and Vice-Principal, M. B. M. Engineering College, Jodhpur.
- Adyalkar, P. G., M.Sc., B.A. (Hindi)** Visharad, F.G.M.S., F.P.S., Senior Exploratory, Tubewells Organisation, Jamnagar House, Mansingh Road, New Delhi-2.
- Adyasharan,** Department of Geography, Patna University, Patna-5.
- Afridi, Mahmoodur Rehman Khan,** Botany Department, Muslim University, Aligarh.
- Agarwal, G. P.,** Lecturer, Mahakosal Mahavidyalaya, 154, Beoharbagh, Jabalpur.
- Agarwal, H. P., Ph.D., A.R.I.C.,** Professor & Head of the Department of Chemistry, Government Hamidia College, Bhopal.
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